

**DETROIT:** FUELING THE IMAGINATION

HOW TO BUILD A **BETTER BEE**

MAY 2015

# NATIONAL GEOGRAPHIC



## THINKING LIKE A DOLPHIN

UNDERSTANDING  
ONE OF THE SMARTEST  
CREATURES ON EARTH



**Okinawa Woodpecker** (*Dendrocopos noguchii*)

**Size:** Body length, approx. 23 cm (9.06 inches); wingspan, approx. 15 cm (5.92 inches)

**Weight:** Approx. 110 g (3.88 oz) **Habitat:** Endemic to Okinawa Island, where it is found solely in the Yanbaru forests **Surviving number:** Estimated at fewer than 100 breeding pairs



Photographed by Shawn Miller

# WILDLIFE AS CANON SEES IT

The few get fewer. One of the world's rarest woodpeckers, the Okinawa woodpecker can be found only in dense, undisturbed forest in the north of its namesake island. Searching out very rotten wood, it excavates deep to uncover wood-boring insects. Females stick primarily to the trees to forage, while males also go to the ground to feast on other insects, berries and seeds.

But venturing down brings the woodpecker into the path of feral cats and mongooses. Facing such deadly predators and deforestation as well, this rare bird is becoming rarer still.

As Canon sees it, images have the power to raise awareness of the threats facing endangered species and the natural environment, helping us make the world a better place.



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In Laos, critics of a planned hydroelectric dam say it will block fish migration on the Mekong River, where this fisherman plies his trade.

## 102 Harnessing the Mekong

Running for more than 2,600 miles, the Mekong River produces fish when it flows free and clean electricity when it's dammed. Therein lies Southeast Asia's dilemma.

By Michelle Nijhuis Photographs by David Guttenfelder

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### It's Time for a Conversation

When one of Earth's smartest creatures vocalizes, it fuels a heated debate among scientists: Are dolphins actually speaking a complex language?

By Joshua Foer  
Photographs by Brian Skerry

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### Taking Back Detroit

With its bankruptcy in the rearview mirror, the Motor City is attracting investors, innovators, and adventurous would-be fixers.

By Susan Ager  
Photographs by Wayne Lawrence

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### Quest for a Superbee

Honeybees top the list of insect pollinators on which one-third of food crops depend. Can we breed a hardier bee?

By Charles C. Mann  
Photographs by Anand Varma

### 130 Proof | Walking the Way

A pilgrimage through France and Spain is "an ancient tradition thriving in a modern world."

Story and Photographs by Michael George

**On the Cover** Scientists working with bottlenose dolphins (this one lives at a Vallejo, California, animal park) are looking for a link between the animals' many vocalizations and their behaviors. Photo by Brian Skerry

**Corrections and Clarifications** Go to [ngm.com/more](http://ngm.com/more).

## Going Home

I'm crisscrossing a careworn street on Detroit's west side, looking at the house where my mother lived in the 1930s. I walk up driveways, down sidewalks, peer around bushes. A neighbor, understandably curious, bounds over.

"I'm the king of Glendale," Keith Harris says. Harris loves Glendale Street—so much so that he's purchased nine properties for \$42,000. That sum got him six houses in varying states of repair and three empty lots.

"I'm not done yet," he says. "I'm going to buy more and rent them."

I'm glad to hear this. Glendale could use more investment. So could Tuxedo Street, a few blocks away, where my father grew up. So could Detroit.

I've seen all the ruin-porn photos. Now I've come to see for myself what's happened to what was America's fifth largest city circa 1950. Then there were more than 1.8 million residents; now there are fewer than 700,000.

This is where my family settled after immigrating to the United States in the 1920s, moving into neighborhoods filled with people just like them.

The handwritten 1940 census page for Tuxedo Street literally illustrates the story: It shows a long list of Jewish names (Goldberg, Cohen, Barsky, Leventen) and the places from which Jews fled (Russia, Latvia, Estonia, Russia, Russia, Russia).

The neighborhood was so insular that when my American-born mother went to kindergarten, she couldn't speak English, only Yiddish.

Those families don't live here anymore. They are gone, along with the elm trees that once shaded these streets. The improbably named Bowl-O-Drome is now a CVS. Some houses have become empty lots. Others, burned-out hulks. But some are tidy symbols of survival and pride. Keith Harris owns one of those homes. "We have clean-up-the-block day," he tells me. "We are trying to make it better."

Visitors like me walk these streets all the time, he says. "Some people came and cried like babies." Maybe they shouldn't have. Though much is gone and more has changed, there are seeds of hope across the city, as writer Susan Ager and photographer Wayne Lawrence discovered while documenting the diversity of the new Detroit for this issue.

Harris has planted some of those seeds. "We invest in this block," he says, "because we want to stay."



In 1932 at age five, Jeannette Goldberg—the editor's mother—posed with her own mother, grandmother, and great-grandmother in Detroit.

Susan Goldberg, *Editor in Chief*



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# Think You're Having a Bad Day? Trust Us, It Could Be Worse . . .



**JULY 1, 1916** No Day at the Beach: In the Jaws of Death.

Charles Epting Vansant became an unwitting American original, in a most horrific way: he was the first to succumb to a shark attack in the nontropical waters of the continental United States.



**JANUARY 1** Crappy New Year!

Fifth-century monk and martyr Telemachus stepped into the middle of a gladiatorial fight in Rome and tried to stop the human slaughter, only to be stoned to death by the bloodthirsty audience unappreciative of the effort.

## Bad Days in History

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History is full of struggle and triumph, determination and discovery, courage and revolution, and let's face it—some really, really bad days. In this wickedly entertaining book, best-selling author and historian Michael Farquhar chronicles the worst of the worst for each day of the year. The mishaps range from eyebrow raising to world changing—think Vegas hotelier Steve Wynn's unfortunate run-in with a priceless Picasso to Napoleon's frost-ridden, troop-depleting defeat in Russia.

For anyone who's had a rough time, this charming romp through history's gloomier side will be grand company.



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# Why Food Is Everything

Chef **José Andrés** moved from Spain to the United States two decades ago. Known for introducing Spanish tapas to the American palate, he's also hosted cooking shows and taught at Harvard (as well as blogged for us at [theplate.nationalgeographic.com](http://theplate.nationalgeographic.com)). Andrés, 45, owns 20 restaurants, but his passion for feeding people continues long after the tables have been cleared.

## **You founded a humanitarian organization, World Central Kitchen. What drives your commitment to feed the hungry?**

My inspiration comes from the unknown names, the people who help, day in and day out, and don't expect anything in return. One thing I did was go to Haiti after the earthquake to cook for people. I think we all should be committing a part of our time for the betterment of the lives of others. This should be a mission statement of humanity, because we can all probably do the same with a little bit less, and that little bit less can be huge for somebody else. My wife and I used our own money to create World Central Kitchen.

## **Why does food education matter?**

Food is national security. Food is economy. It is employment, energy, history. Food is everything. If we approached many of today's issues understanding this importance, we'd be making much better decisions. I believe everybody should be aware, not just of the food they eat but of the implications of eating it.

## **Do you see a future where sustainable choices will be accessible to more people?**

I do, but I think there are problems—in the way we think about cities, for example. If we created huge areas of farmland, especially in poorer places, it would make better food more affordable. What if parts of New York and Washington, D.C., were farms? I understand nobody wants to do that and it might sound crazy, but if we were smart about eating locally and sustainably, we would do great things.







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In four countries with fast-developing economies—Brazil, Russia, India, and China—the agricultural sector has become a proving ground for innovation. Juergen Voegelé, a World Bank agriculture expert, predicts that “by transforming agriculture, we will not only meet the challenge of feeding nine billion people by 2050 but do so in ways that create wealth and reduce its environmental footprint.”

## BRAZIL

# Soybeans on the Rise

Preserving the Amazon rain forest is a top priority for Brazil. The rapid expansion of soybean and cattle farming there during the 1990s and early 2000s led to alarming rates of deforestation. Over the past ten years, however, with government support, activists and farmers have protected more than 33,000 square miles of rain forest—an area equal to more than 14 million soccer fields. Saving these forests has kept 3.5 billion tons of carbon dioxide out of the atmosphere.

Yet even under these land restrictions, Brazil's soybean production has increased. The country is now the world's second largest producer of the crop. How did this happen?

Farmers focused on efficiency. Using new machinery and early maturing seeds enabled them to squeeze an additional planting into the standard growing season. According to the U.S. Department of Agriculture, Brazil's 2014-15 soybean crop will hit a record 104.2 million tons, up 8.6 million tons from the year before, as farmers make better use of their fields. This progress, says the World Bank's Juergen Voegelé, is an example of how “producing more food can be reconciled with protecting the environment.” —Kelsey Nowakowski

## BRAZIL'S SOYBEAN YIELD

Tons per acre.....1.3  
 Million tons produced.....104.2  
 Million acres.....77.8



1990-91  
 Growing season

2014-15





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Brazil's farmers are harvesting soy with newfound efficiency—a result of better seeds, better tools and better harvesting practices. In addition to production, Cargill is helping transport these crops to create a food-secure world, while also helping farmers strengthen their compliance with the country's environmental policies.

Perched on the junction of the Tapajós and Amazon rivers, Cargill's soy export terminal in Pará gives ships quick access to the Atlantic and alleviates congestion in the country's southern ports, which are too far away for most smallholders in the north and west to even reach.

While increasing economic development, Cargill's presence there is encouraging sustainable methods and ethical land use. Through a collaboration with The Nature Conservancy, Cargill has established the *More Sustainable Soy Program*, which aims to support the Brazilian Forest Code implementation and helps expand soy into previously cleared areas, preventing deforestation.

Today, nearly 43 million metric tons are exported each year—quadrupling Brazil's soy business since 2000 and connecting farmers to fruitful trade relationships in Europe, Asia and beyond.

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## INDIA

## *Relying on Rice*

India, the world's second most populous country, is home to more farmers than any other nation. Water availability is a major agricultural concern there, especially for cultivation of rice. Since only 44 percent of the country's agricultural land is irrigated, millions of rice growers must rely on annual monsoons. Over the past 30 years, though, India's farmers have faced challenges as extreme weather events during the monsoon season—including droughts—have become more frequent.

Water-use plans are one tool being used to help thirsty regions. In 2009, with support from the World Bank, the Indian government began a national watershed management program to promote more efficient water use through education and technical support. "Engaging farmers and local communities in managing water resources was key to the success of the watershed program," says the World Bank's Juergen Voegelé. Another innovation: Substantial progress has been made in developing hybrid rice varieties that grow faster while using less water. A new drought-resistant basmati rice variety matures about 30 days earlier than previous crossbred varieties. Farmers across India are already praising the high-yielding variety. —KN

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A woman sorts rice grains in Haridwar, a city in the Indian state of Uttarakhand.





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## How do you feed a country without reliable nutrition? Get creative.

More than one-quarter of the planet's hungry reside in India. In a country with widespread plight, the need for nutrient-rich food is critical and the obstacles many. Not only is India navigating new cycles of drought and rainfall, it faces challenges like food safety and transport.

Cargill's multi-pronged initiative, *Nourishing India*, is focused on improving food security across the country through the distribution and delivery of micronutrients.

The program's first focus was a food found in 95% of households, regardless of income: cooking oil. Cargill fortified all of its Indian oil brands with essential nutrients and vitamins A and D—without altering the cost to consumers. It has helped reverse the effects of malnutrition in more than 30 million people in India.

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## RUSSIA

## *Wheat in a New Climate*

Russia is a major exporter of grains, including wheat. In the face of sanctions and import bans, the country has recently focused on growing more of its own food and has boosted government funding for agricultural technologies that increase production.

These efforts must take into account predicted shifting temperatures. A warming climate and increasing precipitation will likely expand the amount of land that could be cultivated in coming years. But economic models predict that—largely due to floods, droughts, and heat and cold waves—wheat production could decrease by up to 15 percent within five years.

To combat the negative effects of climate change, Russia is looking to conservation agriculture. Inexpensive, low-tech solutions such as no-till farming could reduce soil erosion in the country's steppe regions. Siberia's arid Kulunda Steppe, for example, suffers from poor soil conditions; some 50 percent of its farmland is already degraded. Initial testing of no-till farming in the region looks promising, with yields improving up to 25 percent. The World Bank's Juergen Voegelé says Russia is "among the top five countries in the world" in conservation agriculture because of its rapid adoption of practices that are both financially profitable and environment friendly. —KN





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## How do you resurrect an industry in times of change? Start over.

Russia is no stranger to change, from new agricultural conditions to new trade mandates. And now, new promise in the dairy industry.

Five years ago, its average dairy yield dropped to near-crisis conditions. Poor farm management and slow agribusiness had forced dairy farmers to use lower-quality animal feeds, leading to smaller yields per cow, a nation-wide milk deficit and widespread health issues.

To restore production, Cargill helped 50 farms start over. Partnering with two global dairy distributors, Cargill taught smallholder farmers to embrace new technologies and adapt more sophisticated feed systems. By focusing on quality, farmers also increased quantity: one farm's daily per-cow yield jumped from 1.5 to 3.5 liters.

Not only has production of nutrient-rich dairy resumed with confidence, it's quickly become a major industry for Russia in the global marketplace.

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the world thrive at [cargill.com/150](https://cargill.com/150)



## CHINA

## Corn Takes the Lead

Diets have shifted in China—and so too has its top crop. Since 2011 the country has grown more corn than rice. Corn production has jumped nearly 125 percent over the past 25 years, while rice has increased only 7 percent. A taste for meat is behind the change: A significant portion of its corn is used to feed chickens, pigs, and cattle.

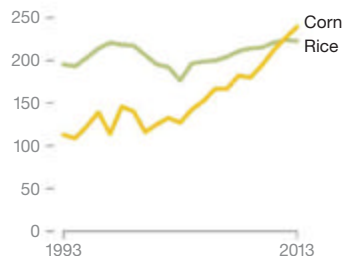
Another reason for corn's rise: Government incentives encourage farmers near Beijing to grow corn instead of rice to improve water quality. Corn uses less water than rice and creates less fertilizer runoff. This switch has decreased pollution in the city's major reservoir and made drinking water safer for residents.

According to the World Bank, China accounts for about 30 percent of total global fertilizer consumption. The Chinese Ministry of Agriculture estimates that between 2005—when the government started a soil-testing program that gives site-specific fertilizer recommendations to farmers—and 2011, fertilizer use dropped by 7.7 million tons. That prevented the emission of 51.8 million tons of carbon dioxide. China's approach to improving its environment while feeding its citizens “offers useful lessons for agriculture and food policymakers globally,” says the bank's Juergen Voegele. —KN

Harvested corn is dried by the sun in a village near Gaomi, in China's Shandong Province.

### CHINA'S CORN AND RICE PRODUCTION

Millions of tons







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China is the world's largest producer and consumer of pork, but its ever-increasing demand for other meats like chicken is posing big obstacles.

For the past three decades, the country's poultry consumption has been on the rise, but the challenge to achieve food safety persists. Cargill has taken an innovative approach to set a new precedent, developing a fully integrated poultry supply chain with the highest biosecurity and food safety protocols, designed to address complex issues like traceability and cross-contamination.

Teaming a large-scale facility with 35 farms strategically located in isolated areas, Cargill ensures responsible sourcing and prevents potential contamination from other operations. Not only is the system delivering safe, responsibly sourced products to customers and consumers, it's become a model in the eyes of animal welfare and sustainability organizations across China.

Explore how Cargill is helping  
the world *thrive* at [cargill.com/150](https://cargill.com/150)

# EXPLORE



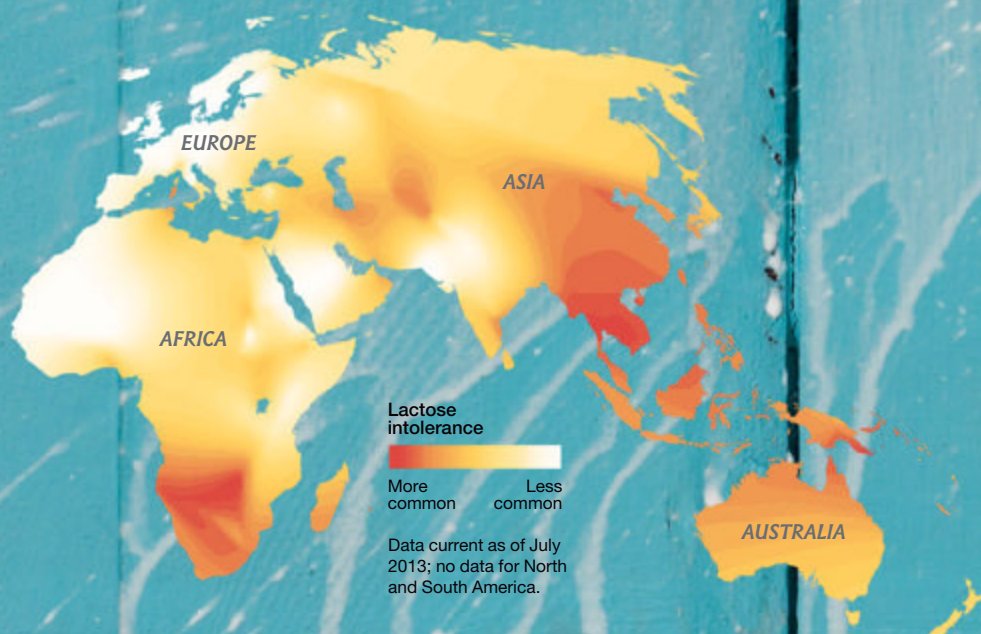
Us

## *How Milk Goes Down Around the World*

Got milk? If so, you also may get stomach pain after you drink a glass of it. That's because most of the world's adults—an estimated 68 percent—aren't able to digest it.

Their condition is commonly called lactose intolerance. It stems from a lack of lactase, an enzyme that breaks down the milk sugar lactose. Lactase is present in young children but weakens in most people after weaning, says evolutionary geneticist Pascale Gerbault. The enzyme continues to be produced, extending the ability to digest dairy, only in smaller populations of adults around the globe.

Though what sparked the digestion divide is uncertain, Gerbault says, one pattern may shed light: Milk tolerance in adults is more common in regions with a history of raising dairy mammals, such as cattle, goats, and sheep. —Catherine Zuckerman







## The Future of Food

The stories in this section are part of a five-year National Geographic initiative to show how what we eat makes us who we are.



EXPLORE

Ancient Worlds



The kitchen in this mural from a villa in Pompeii is stocked with a rare food, thrushes, and a common one, eggs.

## *Feasts of the Romans*

Pheasant dumplings. Ostrich stew. Roasted flamingo. Recipes surviving from ancient Rome suggest that such delicacies may have been served at posh banquets. However, archaeologists who've picked through the trash heaps of history—dumps, sewers, and cesspits—say such exotic treats were rare then, and Romans generally ate locally sourced foods very similar to what Italians eat today.

At the coastal site of Herculaneum, in a sewer that was in use until the catastrophic volcanic eruption of Mount Vesuvius in A.D. 79, archaeologists have found a wealth of clues to the locals' diet. Sifting through the remains of scraps flushed down the drains of shops and apartments, they've identified 114 different foods—45 species of fish alone, as well as traces of pigs, sheep, and chickens and a variety of herbs, fruits, nuts, and grains.

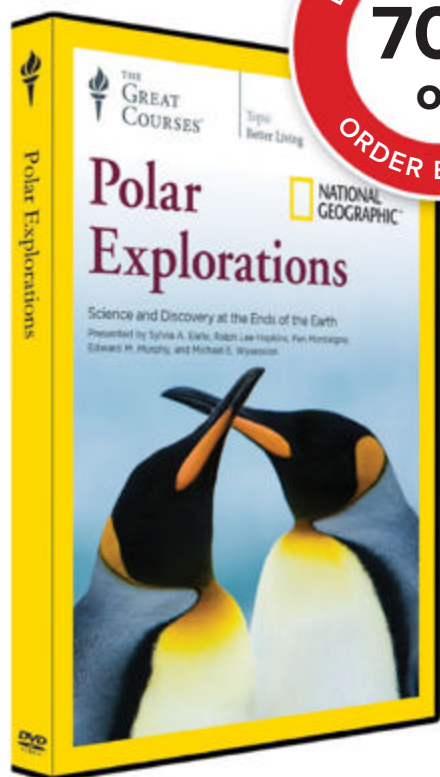
In the ruins of nearby Pompeii, the University of Winnipeg's Michael MacKinnon has studied the leftovers of Romans' favorite meat: pork. Rich and poor ate it, fixed according to their means, he says: "They'll both have a pork chop on their plate, but the rich will probably put more expensive spices on it." —A. R. Williams

### MEAT MUMMY

Prepared as food for eternity, beef ribs in a coffin were buried with King Tut's great-grandparents in Egypt in about 1350 B.C. Now a study has identified the resin used to preserve the meat: sap from trees related to the pistachio. The sap may also have served as flavoring. "This mummy may show the origins of using it in food," says study co-author Salima Ikram. Today a type of the smoky resin, called mastic, spices up dishes and drinks in countries around the Mediterranean. —ARW







## Explore the Wonder and Beauty of the Polar Regions

Enchanting and otherworldly in their beauty, the polar regions are some of the most isolated and least understood places on Earth. And yet, these extreme environments are endlessly fascinating, and eminently worthy of experiencing firsthand, especially if you are prepared to understand what you are seeing.

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5. The Icy Heart of Polar Seas
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7. Science and Spirits of the Arctic Sky
8. Indigenous Peoples of the Arctic
9. Greenland and Arctic Islands
10. Terrestrial Mammals in the Changing Arctic
11. Seabirds of the Arctic and Antarctic
12. Marine Mammals, from Whales to Walruses
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## ***Food Fight***

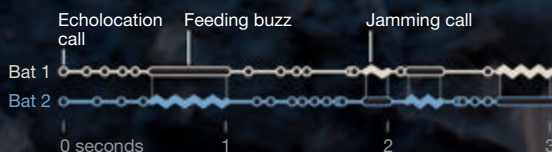
Warships use sonar to detect targets and jamming technology to thwart enemy sonar. Mexican free-tailed bats can do both those things with their vocal cords.

Bats use echolocation, bouncing sound waves off an object, to navigate and draw a bead on prey. Aaron Corcoran and William Conner, scientists at Wake Forest University, recently discovered that Mexican free-tailed bats also use these signals to interfere with one another's hunts.

When one of the bats is homing in on an insect, it increases the rate of its signals to a rapid "feeding buzz." If a second, nearby bat emits a jamming signal, that may confuse the reading Bat 1 gets on the insect, giving Bat 2 an opening to steal it. Not to be outdone, Bat 1 may send its own jamming signal, starting a back-and-forth battle. Corcoran hopes to learn whether the behavior is unique to Mexican free-tailed bats, which—living in colonies of a million plus—must compete for meals. —*Lindsay N. Smith*

### **COMPETITIVE EATERS**

Corcoran plotted the interactions of two Mexican free-tailed bats hunting for the same moth and emitting competing feeding buzzes and jamming signals.





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EXPLORE

## By the Numbers

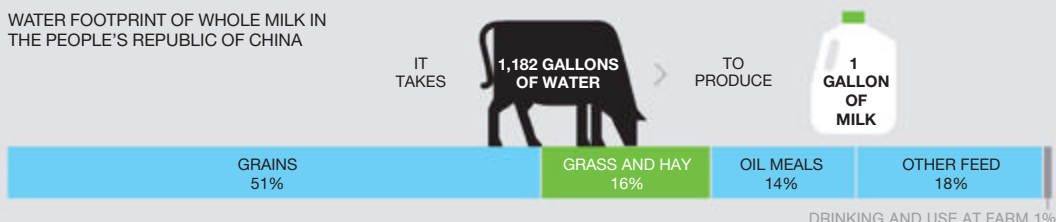
# Thirsty Exports

Even though many farmers struggle to meet their crops' demand for water in places such as drought-stricken California, every year they send billions of virtual gallons to other countries—in the form of the food and feed grown with that water. According to Arjen Hoekstra of the Netherlands' University of Twente, the issue of agriculture's water footprint—all the water used to produce a commodity and get it to a consumer—is contentious, since many farmers use scarce water to produce low-value export crops. Water is a public good, he says, so allocation systems ought to support its sustainable use. —Kelsey Nowakowski

## CHINA'S RISING DAIRY DEMAND

Chinese consumers drink more milk today than ever before. Because their appetite for dairy products is growing faster than Chinese farmers' capacity to feed dairy cattle, those farmers now rely on alfalfa hay imports from the U.S.

### WATER FOOTPRINT OF WHOLE MILK IN THE PEOPLE'S REPUBLIC OF CHINA



Alfalfa improves the amount and quality of milk produced by dairy cows.

### RAW MILK PROTEIN CONTENT IN CHINA



ALFALFA IS CALIFORNIA'S LARGEST AGRICULTURAL WATER USER, CONSUMING MORE THAN FIVE MILLION ACRE-FEET\*\* A YEAR.

## U.S. ALFALFA HAY IMPORTED BY CHINA

After dropping off Chinese goods in California ports, many containers are filled with alfalfa for the return trip. It's often more cost-effective to send alfalfa from Los Angeles to Beijing than from California's Imperial Valley to its Central Valley, where many dairy farms are located.



\*Virtual water flow is all water used to produce a commodity, transferred virtually through trade to the consuming country.

\*\*One acre-foot is the amount of water that would cover one acre to a depth of one foot, or 325,851 gallons.



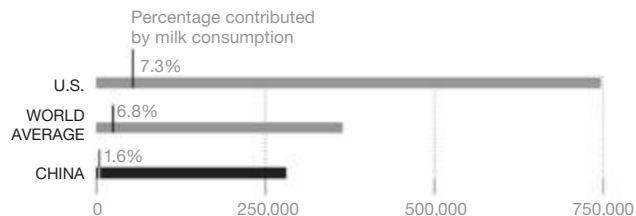
#### VIRTUAL WATER FLOW\*

● Net exporters ● Net importers



#### AVERAGE ANNUAL WATER FOOTPRINT

*gallons per capita, 1996-2005*

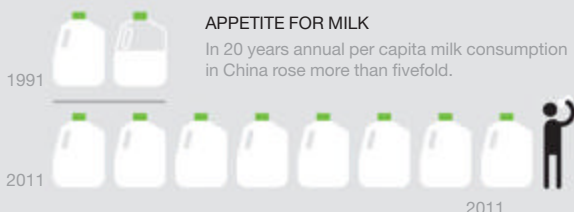


#### TONS OF U.S. ALFALFA IMPORTED BY CHINA

648,980

#### APPETITE FOR MILK

In 20 years annual per capita milk consumption in China rose more than fivefold.



310  
THOUSAND

#### ACRE-FEET OF WATER

are used to grow the U.S. alfalfa exported to China every year.

800  
THOUSAND

#### AMERICAN FAMILIES

use the same amount of water annually that's used to grow alfalfa in California.

#### CHINA'S DAIRY COW IMPORTS

From 2008 to 2011 imports of Australian, New Zealand, and Uruguayan cows—twice as productive as Chinese cows—grew almost 600 percent. To feed those cows, hay demand increased dramatically.



#### GOVERNMENT PUSH

"I have a dream, and my dream is that each Chinese person, especially the children, can afford to buy one jin [18 fl. oz.] of milk to drink every day."

PREMIER WEN JIABAO, 2006



21,321

206,923

2006

2008

2011

2013



EXPLORE  
**Planet Earth**



## *Salt of the Earth*



Each day about 5,000 acres of farmland worldwide become too salty to sustain crops profitably. All land is naturally vulnerable to either sodium or sodium chloride (or both) that accumulates in soil. Poor drainage can make it linger. When salt builds up around roots, plants work harder to grow. In all, a study shows, more than 153 million acres of irrigated land—about the size of France—have become unfarmable.

Farmers won't be the ones to fix the problem, though, according to Manzoor Qadir, a soil and irrigation specialist at United Nations University. Instead, he says, governments need to mandate field drainage on a large scale. A more immediate solution may come from plants themselves. Research indicates that food crops such as wheat and rice could be genetically engineered to resemble plants like seaweed, which evolved salt tolerance long ago. —Daniel Stone

Farmers in Bangladesh's Satkhira region have converted saline rice fields into ponds (above) to raise shellfish.

On nearly every continent, salt-affected soil has made areas difficult to farm.

Soil significantly affected by salt

-  Naturally occurring
-  Human-induced

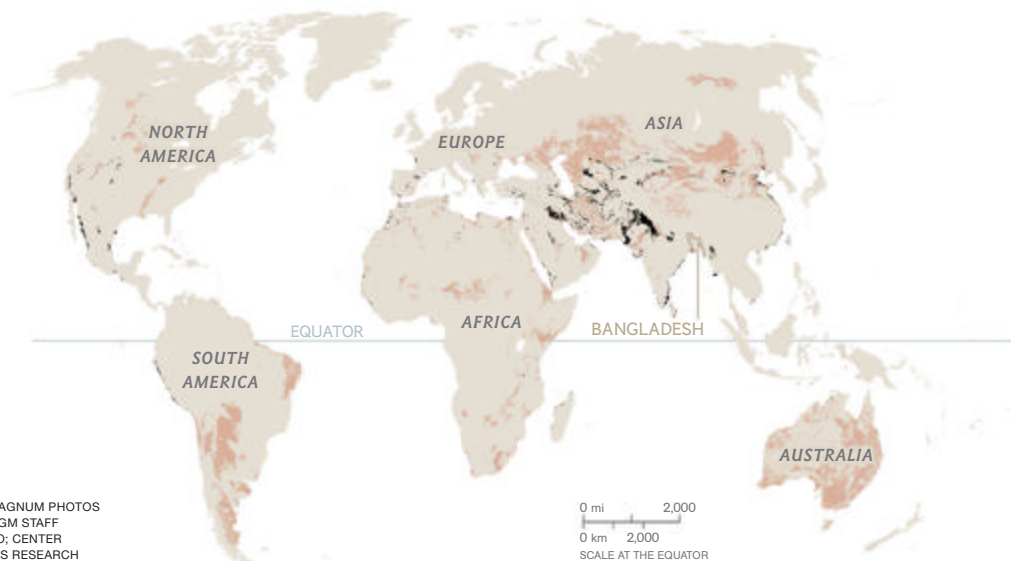


PHOTO: JONAS BENDIKSEN, MAGNUM PHOTOS  
MAP: JEROME N. COOKSON, NGM STAFF  
SOURCES: EDDY DE PAUW; FAO; CENTER FOR ENVIRONMENTAL SYSTEMS RESEARCH

0 mi 2,000  
0 km 2,000  
SCALE AT THE EQUATOR



Started my Camry.  
Wanted tacos for lunch.  
Crossed down into Baja.  
Joined a soccer game.  
Lost my passport to a seagull.  
Hitched a ride on a cargo ship.  
Got boarded by pirates.  
Freed some livestock.  
Retook the ship.  
They were really good tacos.

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**Let's  
Go  
Places**



EXPLORE  
Science

## *Hot Potatoes*

This year a genetically engineered potato may hit a grocery store near you. Using a technique called RNA interference (RNAi), scientists have silenced genes that lead potatoes to bruise and to brown when exposed to air—the two characteristics that land roughly 30 percent of harvested potatoes in the trash. These new spuds also contain up to 70 percent less of an amino acid that transforms into a cancer-causing compound at high temperatures. A second version will be resistant to late blight, the disease that caused the Irish potato famine.

The J. R. Simplot Company that created the potato calls it Innate since it doesn't contain genes from other species. Even so, McDonald's won't be serving it. RNAi is a "very routine procedure in research," says Kent Bradford, a biologist at the University of California, Davis, but "the marketing situation for genetically engineered products is toxic." —Rachel Hartigan Shea

One day after slicing, ordinary potatoes had turned brown; the genetically engineered potatoes remained pale.





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## Basic Instincts

A genteel disquisition on love and lust in the animal kingdom

# A Girl's Gotta Eat

Food. Sex. They're primal preoccupations for humans and our close relatives, chimpanzees. For years *Homo sapiens* scientists have watched those appetites play out among *Pan troglodytes* with mixed results.

Female chimps average five to six years between births, one of the longest intervals of any mammal. To raise the odds of reproducing, a female will mate "with most or all of the males she knows," says primatologist Melissa Emery Thompson, while a male will compete or fight with other would-be sires. Some studies report cases of male chimps trying to sweeten the deal: sharing game they killed, or crops they filched, with females that mated with them. In a 2007 West African chimp study, a female consorted more frequently with a male that gave her stolen papayas, leading researcher Kimberley Hockings to suggest the male was trading "forbidden fruit" for "other currencies."

Many studies don't support the food-for-sex theory, Emery Thompson says: "People tend to hang on to the idea because they find it titillating." What her chimp research has found, she says, is a different food-sex issue. With sex-seeking males surrounding them, females are less able to forage and feed. That drives down fertility and their ability to replenish their endangered species. —Patricia Edmonds

### HABITAT/RANGE

Forests and savanna woodlands in 21 African nations

### CONSERVATION STATUS

Endangered

### OTHER FACTS

Female chimps mate promiscuously so that many males think they might be a baby's father; that discourages infanticide.

**A female chimp will mate "with most or all of the males she knows."**





# If you own or owned property with windows made by M.I. Windows, you may qualify for benefits from a class action settlement.

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A proposed Settlement has been reached with M.I. Windows and Doors, LLC ("MIWD") relating to tape glazed windows manufactured by MIWD between July 1, 2000 and March 31, 2010. The lawsuit alleged water leakage and resulting damage to Class Members' windows and property. MIWD denies the allegations and there has been no determination of wrongdoing by the Court.

## Who is included?

The Settlement includes both homeowners and contractors who own or owned a home or other structure with the included MIWD windows. A complete list of the windows covered by the Settlement can be viewed at [www.MIWDTapeGlazedWindowSettlement.com](http://www.MIWDTapeGlazedWindowSettlement.com). The website has photographs and detailed instructions on how to identify if your windows are part of the Settlement.

## What does the Settlement provide?

If you have windows that are included in the Settlement, you may be able to make a claim for money, repair service or other benefits. The amount you may make a claim for will depend on a number of factors, including (1) the number of affected windows, (2) whether water leaked, causing a visible residue line, water staining or additional property damage, and (3) whether you previously paid money for certain repairs. Class Members may be able to receive monetary compensation plus replacement

window sashes and repairs. The Settlement creates several categories of benefits. Visit the website for detailed information.

## How do I make a Claim?

You can file an online claim now at the website. You can also download a paper Claim Form at the website or request one by calling the toll-free number below. There are multiple claim categories with different deadlines. The earliest deadline is **October 26, 2015**.

## Your other options.

If you do not want to be legally bound by the Settlement, you must exclude yourself from the Class by **May 28, 2015**, or you will not be able to sue MIWD about the legal claims the Settlement resolves, ever again. If you exclude yourself, you cannot get money or other benefits from the Settlement. If you stay in the Class, you may object to it by **June 1, 2015**. The detailed notice available on the website explains how to exclude yourself or object.

The Court will hold a hearing, on **June 30, 2015**, to consider whether to approve the Settlement, and a request by Class Counsel for attorneys' fees, costs, and expenses of no more than \$9,045,000 and incentive awards for the Class Representatives of \$5,000. You or your own lawyer, if you have one, may ask to appear and speak at the hearing at your own cost, but you do not have to.

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# VISIONS







**China**  
A big family eats with the fishes at Tianjin Haichang Polar Ocean World. The complex's new 150-foot-long tunnel—made of glass that is 4.7 inches thick—offers a panoramic view of 50-plus types of fish, including zebra sharks and giant groupers.

PHOTO: CHINA STRINGER NETWORK/REUTERS







## Indonesia

In Cenderawasih Bay a whale shark's maw gapes before an easy meal. Local fishermen believe this species—the world's largest fish—is good luck, so they leave their nets filled with baitfish. That keeps these sharks in the bay year-round.

PHOTO: ADRIANA BASQUES









#### South Korea

Traditions are bridged in modern Seoul. Styled for an artist's project, a young woman wears *hanbok*—a centuries-old clothing style noted for its vibrant colors. The outsize sculpture is a nod to the big role fish play in Korean cuisine.

PHOTO: JULIA  
FULLERTON-BATTEN

## Your Shot

ASSIGNMENT



Sponsored by



# Someday

From ballooning in exotic locales to finding true love to retiring by the beach, National Geographic's January/February **Your Shot** photo assignment, *Someday*, inspired creativity and helped this photography community focus on aspirations. **The Your Shot editors reviewed more than 12,000 submissions and created a story from the finalists, which you can see at [ngm.com/yourshot](http://ngm.com/yourshot).** Here are some of their top picks.

### Home Sweet Home by Teran Jones, United States

This image looks as if it was hand-tinted with its perfectly placed color swaths of blue and yellow-muted pastels shining bright in the sunshine. The well-worn trailer adds to the vintage quality of this photo. I can hear the highway calling... the open road lies ahead.



### On the Road by Donna Tzaneva, Bulgaria

The woman's eyeglasses mirror the panes of glass in the train window. Both offer a view into other worlds—the lush tropical landscape or the daydreams of a Thai woman. Showing her with closed eyes helps the viewer feel as if they are watching an intimate moment... maybe she is dreaming about her someday.



### Passing Flight by Joe Almond, France

Each person tells a different story in this photo. What can you decipher from their posture and clothing? I like the horizontal layers: the legs, the chairs, the people, the band of empty blue sky that gives your eye a rest. And then finally a single airplane comes into view, the last piece of the puzzle.





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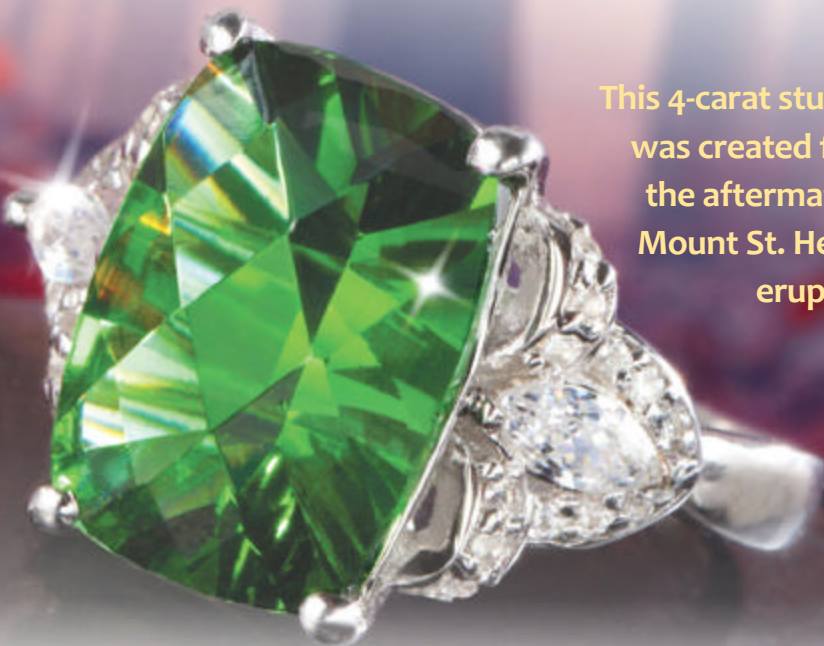
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# Hunger and Hope

**Assignment** We asked the Your Shot community for images not of food, but of people striving to have enough of it.



## EDITOR'S NOTE

“It is easy to snap shots of sad and seemingly hopeless situations. Great images require a commitment of time and creativity that honor the subject and tell a compassionate story.”

—Annie Griffiths, *National Geographic* photographer



**Sudipta Maulik**  
Kolkata, India

During Annakut, a festival honoring the Hindu Lord Krishna, religious devotees gather to catch rice, which symbolizes abundance for the year ahead. Maulik waited six hours on a veranda for the moment the rice would be thrown to the faithful.

**Alexandr Polishchuk**  
Gvardeysk, Russia

Polishchuk saw a woman standing motionless for 15 minutes in front of a store. Curious, he took one photo. Then the woman's son arrived to pick her up. “After that, my acquaintance with them ended,” Polishchuk says, “but emotions were left.”

# IT'S TIME FOR A CONVERSATION





***Breaking the  
communication  
barrier between  
dolphins and humans***

Spinner dolphins return from foraging to a bay off Oahu, Hawaii. Garrulous and gregarious, spinners gather in groups that can number in the thousands.







Relative to body size, the brains of bottlenose dolphins, like these at the Roatán Institute for Marine Sciences in Honduras, are among the largest in the animal kingdom. Scientists are attempting to decode dolphins' complex vocalizations.







By Joshua Foer  
Photographs by Brian Skerry

## UNDERSTANDING DOLPHINS



INTELLIGENCE  
CAPTIVITY  
CULTURE

*a three-part series*

Head trainer Teri Turner Bolton looks out at two young adult male dolphins, Hector and Han, whose beaks, or rostra, are poking above the water as they eagerly await a command.

The bottlenose dolphins at the Roatán Institute for Marine Sciences (RIMS), a resort and research institution on an island off the coast of Honduras, are old pros at dolphin performance art. They've been trained to corkscrew through the air on command, skate backward across the surface of the water while standing upright on their tails, and wave their pectoral fins at the tourists who arrive several times a week on cruise ships.

But the scientists at RIMS are more interested in how the dolphins think than in what they can do. When given the hand signal to “innovate,” Hector and Han know to dip below the surface and blow a bubble, or vault out of the water, or dive down to the ocean floor, or perform any of the dozen or so other maneuvers in their repertoire—but not to repeat anything they've already done during that session. Incredibly, they usually understand that they're supposed to keep trying some new behavior each session.

Bolton presses her palms together over her

head, the signal to innovate, and then puts her fists together, the sign for “tandem.” With those two gestures, she has instructed the dolphins to show her a behavior she hasn't seen during this session and to do it in unison.

Hector and Han disappear beneath the surface. With them is a comparative psychologist named Stan Kuczaj, wearing a wet suit and snorkel gear and carrying a large underwater video camera with hydrophones. He records several seconds of audible chirping between Hector and Han, then his camera captures them both slowly rolling over in unison and flapping their tails three times simultaneously.

Above the surface Bolton presses her thumbs and middle fingers together, telling the dolphins to keep up this cooperative innovation. And they do. The 400-pound animals sink down, exchange a few more high-pitched whistles, and then simultaneously blow bubbles together. Then they pirouette side by side. Then they tail walk. After eight nearly perfectly synchronized sequences, the session ends.

There are two possible explanations of this remarkable behavior. Either one dolphin is mimicking the other so quickly and precisely that the

Reading Stan Kuczaj's command—the arrow means “sink backward to the ocean floor”—is child's play for this bottlenose at Roatán. “Observing dolphins solve problems like this is essential if we wish to understand how dolphins think,” he says.

apparent coordination is only an illusion. Or it's not an illusion at all: When they whistle back and forth beneath the surface, they're literally discussing a plan.

**W**hen a chimpanzee gazes at a piece of fruit or a silverback gorilla beats his chest to warn off an approaching male, it's hard not to see a bit of ourselves in those behaviors and even to imagine what the animals might be thinking. We are, after all, great apes like them, and their intelligence often feels like a diminished—or at least a familiar—version of our own. But dolphins are something truly different. They “see” with sonar and do so with such phenomenal precision that they can tell from a hundred feet away whether an object is made of metal, plastic, or wood. They can even eavesdrop on the echolocating clicks of other dolphins to figure out what they're looking at. Unlike primates, they don't breathe automatically, and they seem to sleep with only half their brains resting at a time.

study, nobody can say what the fundamental units of dolphin vocalization are or how those units get assembled.

“If we can find a pattern connecting vocalization to behavior, it'll be a huge deal,” says Kuczaj, 64, who has published more scientific articles on dolphin cognition than almost anyone else in the field. He believes that his work with the synchronized dolphins at RIMS may prove to be a Rosetta stone that unlocks dolphin communication, though he adds, “The sophistication of dolphins that makes them so interesting also makes them really difficult to study.”

Yet virtually no evidence supports the existence of anything resembling a dolphin language, and some scientists express exasperation at the continued quixotic search. “There is also no evidence that dolphins cannot time travel, cannot bend spoons with their minds, and cannot shoot lasers out of their blowholes,” writes Justin Gregg, author of *Are Dolphins Really Smart? The Mammal Behind the Myth*. “The ever-present scientific caveat that ‘there is much we do not know’ has allowed dolphinese proponents to slip the idea of dolphin language in the back door.”

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**Either one dolphin is mimicking the other, or when they whistle to each other below the surface, they're literally discussing a plan.**

Their eyes operate independently of each other. They're a kind of alien intelligence sharing our planet—watching them may be the closest we'll come to encountering ET.

Dolphins are extraordinarily garrulous. Not only do they whistle and click, but they also emit loud broadband packets of sound called burst pulses to discipline their young and chase away sharks. Scientists listening to all these sounds have long wondered what, if anything, they might mean. Surely such a large-brained, highly social creature wouldn't waste all that energy babbling beneath the waves unless the vocalizations contained some sort of meaningful content. And yet despite a half century of

But where Gregg sees a half century of failure, Kuczaj and other prominent researchers see a preponderance of circumstantial evidence that leads them to believe that the problem simply hasn't yet been looked at in the right way, with the right set of tools. It's only within the past decade or so that high-frequency underwater audio recorders, like the one Kuczaj uses, have been able to capture the full spectrum of dolphin sounds, and only during the past couple of years that new data-mining algorithms have made possible a meaningful analysis of those recordings. Ultimately dolphin vocalization is either one of the greatest unsolved mysteries of science or one of its greatest blind alleys.



Until our upstart genus surpassed them, dolphins were probably the largest brained, and presumably the most intelligent, creatures on the planet. Pound for pound, relative to body size, their brains are still among the largest in the animal kingdom—and larger than those of chimpanzees. The last common ancestor of humans and chimps lived some six million years ago. By comparison cetaceans such as dolphins split off from the rest of the mammal lineage about 55 million years ago, and they and primates haven't shared an ancestor for 95 million years.

This means that primates and cetaceans have been on two different evolutionary trajectories for a very long time, and the result is not only two different body types but also two different kinds of brains. Primates, for example, have large frontal lobes, which are responsible for executive decision-making and planning. Dolphins don't have much in the way of frontal lobes, but they still have an impressive flair for solving problems and, apparently, a capacity to plan for the future. We primates process visual information in the back of our brains and language and auditory information in the temporal lobes, located on the brain's flanks. Dolphins process visual and auditory information in different parts of the neocortex, and the paths that information takes to get into and out of the cortex are markedly different. Dolphins also have an extremely well developed and defined paralimbic system for processing emotions. One hypothesis is that it may be essential to the intimate social and emotional bonds that exist within dolphin communities.

"A dolphin alone is not really a dolphin," says Lori Marino, a biopsychologist and executive director of the Kimmela Center for Animal Advocacy. "Being a dolphin means being embedded in a complex social network. Even more so than with humans."

When dolphins are in trouble, they display a degree of cohesiveness rarely seen in other animal groups. If one becomes sick and



Denise Herzing (at right), who studies dolphins off the Bahamas, wears a computer that produces dolphin whistles she hopes will lay the foundation for a shared vocabulary.

heads toward shallow water, the entire group will sometimes follow, which can lead to mass strandings. It's as if they have a singular focus on the stranded dolphin, Marino says, "and the only way to break that concentration may be to give them something equally strong to pull them away." A mass stranding in Australia in 2013 was averted only when humans intervened, capturing a juvenile of the group and taking her out to the open ocean; her distress calls drew the group back to sea.

Why did dolphins, of all the creatures roaming land and sea, acquire such large brains? To answer that question, we must look at the fossil record. About 34 million years ago the ancestors of modern dolphins were large creatures with wolflike teeth. Around that time, it's theorized, a period of significant oceanic cooling shifted food supplies and created a (Continued on page 46)

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*Joshua Foer wrote Moonwalking With Einstein: The Art and Science of Remembering Everything. Brian Skerry, a contributing photographer since 1998, was named a National Geographic photography fellow in 2014.*





Dolphins communicate with their bodies as well as with sounds. A dusky dolphin catapulting through the air off the coast of Patagonia may be sending a signal to other dolphins: The food here is good. Come and get it.





Intensely social, dolphins work together on ingenious feeding strategies. Dusky dolphins off Patagonia herd anchovies into neat spheres and then take turns gulping. Two birds, a Magellanic penguin and a shearwater, join the frenzy.





## Cerebral Matters

Both humans and dolphins have invested a lot in evolving a big brain, though sometimes to different ends. Dolphins don't process high-level information in enlarged frontal lobes as we do, but they're adept at solving problems and can apparently plan for the future.

### DIFFERENCES BETWEEN DOLPHIN AND HUMAN BRAINS

#### Auditory nerve

The auditory nerve in dolphins is twice as wide as it is in humans. More nerve fibers allow dolphins to make sense of sounds quickly.

#### Visual organs

Dolphins' visual center sits right next to the auditory cortex, allowing their brains to translate sounds into images and images into sounds.

#### Corpus callosum

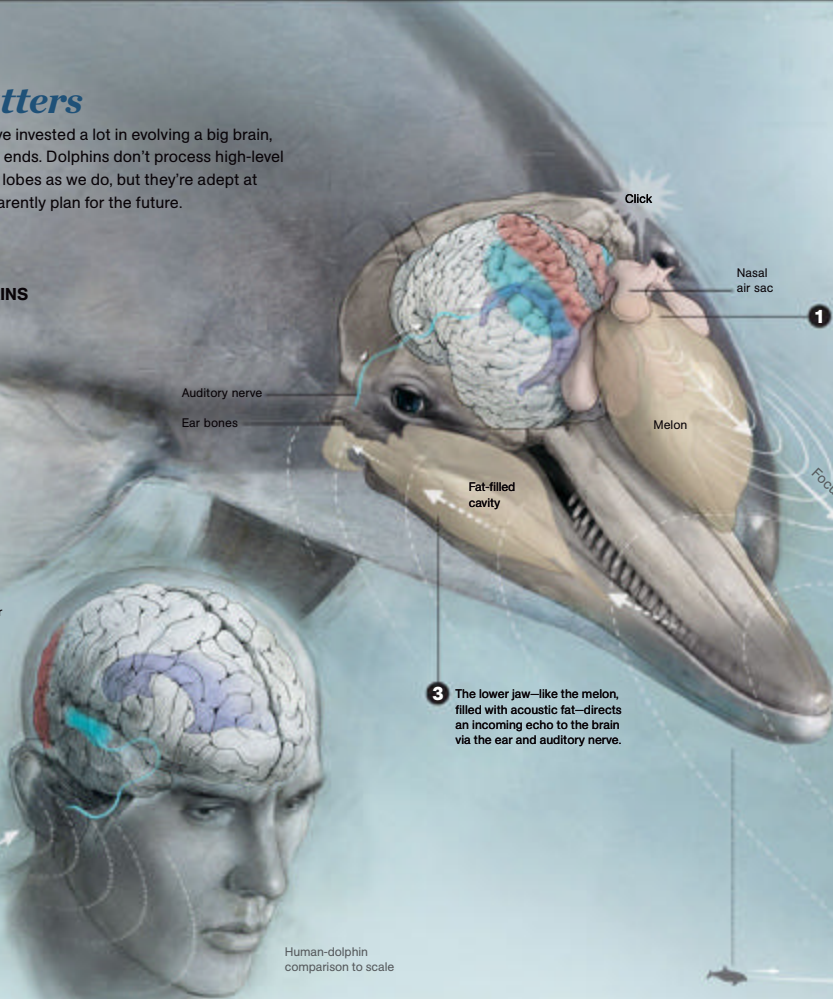
Four times as large in humans as in dolphins, this nerve bundle in the center of the brain connects the two cerebral hemispheres. Dolphins appear to shut down one hemisphere to sleep, and stay alert with the other.

Dolphin Human



#### Cerebral cortex

Dolphins have a more complicated network of gyri and sulci (ridges and grooves) than humans do. More blood flows to their brains to feed the high metabolism needed for marine life.



## Seeing With Sound

Dolphins have evolved a way to see objects underwater using sound. Sound travels faster in water than in the air.

### HOW ECHOLOCATION WORKS

**1** Dolphins produce clicks by pushing air past structures called phonic lips, which are attached to the blowhole. The sound is then beamed through fatty tissue called the melon. Changing the shape of the melon directs the beam.

**3** The lower jaw—like the melon, filled with acoustic fat—directs an incoming echo to the brain via the ear and auditory nerve.

Echolocating dolphins can identify targets as far away as half a mile.

### DOLPHIN BEHAVIORS

#### Using tools

In Australia some dolphins put marine basket sponges on their rostra, or beaks, to protect against abrasion while they probe the seafloor for prey.

#### Teaming up

Two small groups of males sometimes work together to herd a female away from her companions. If they succeed, one of the groups gets to mate with her.

#### Strand feeding

Some dolphins will charge toward shore, making waves that force fish onto land. The dolphins then beach themselves to feast.

#### Remember

Dolphins can recognize other dolphins encountered days or weeks ago.

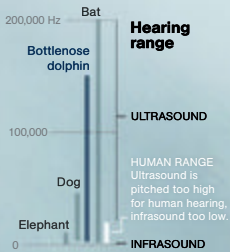
FERNANDO G. BAPTISTA AND DANIELA SANTAMARINA, NGM STAFF; MESA SCHUMACHER  
INTERNAL STRUCTURE ILLUSTRATIONS: SHIZUKA AOKI. TEXT: RACHEL HARTIGAN SHEA

SOURCES: SAM RIDGWAY, NATIONAL MARINE MAMMAL FOUNDATION; DENISE HERZING, WILD DOLPHIN PROJECT; HOWARD UNIVERSITY; DIANA REISS, HUNTER COLLEGE, CUNY; JUAN TRONCOSO, JOHNS HOPKINS UNIVERSITY



## th Sound

sensory system to detect  
g the echoes created by  
ur times as fast in the



**2** The beam of clicks bounces off the target and returns to the echolocating dolphin. Clicks can be overheard by neighboring dolphins.



ing each other  
recognize the signature whistles of  
y, perhaps even if the animals haven't  
each other for as long as 20 years.

RACHEL RACICOT.



## THE DOLPHIN FAMILY

Body dimensions vary among the more than 30 species of marine dolphins, which include killer whales (orcas).

Killer whale, 23-32 ft  
(*Orcinus orca*)



Risso's dolphin, 10-14 ft  
(*Grampus griseus*)



Common bottlenose, 7-13 ft  
(*Tursiops truncatus*)  
Enlarged at far left



Atlantic white-sided, 8-9 ft  
(*Lagenorhynchus acutus*)



Spinner dolphin, 6-7 ft  
(*Stenella longirostris*)



Dusky dolphin, 6 ft  
(*Lagenorhynchus obscurus*)



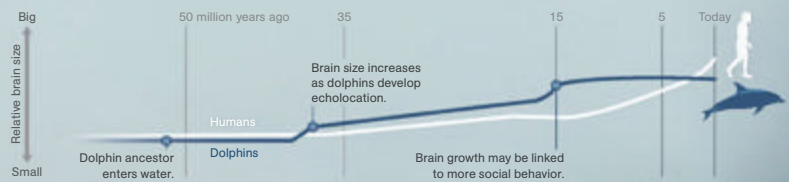
Maui's dolphin, 4-6 ft  
(*Cephalorhynchus hectori maui*)

## DOLPHINS

# A Mind of Their Own

Since the ancestors of dolphins left their fellow mammals behind and entered the water more than 50 million years ago, humans and dolphins have evolved radically different bodies adapted to wholly separate environments. But we share one notable piece of anatomy—a large, complicated brain. Among the challenges to our own big brains: penetrating the mystery of how dolphins use theirs.

## BRAIN EVOLUTION



new ecological niche, which offered dolphins opportunities and changed how they hunted. Their brains became larger, and their terrifying teeth gave way to the smaller, peglike teeth that dolphins have today. Changes to inner-ear bones suggest that this period also marked the beginnings of echolocation, as some dolphins likely changed from solitary hunters of large fish to collective hunters of schools of smaller fish. Dolphins became more communicative, more social—and probably more intelligent.

Richard Connor, who studies the social lives of dolphins in Shark Bay, Australia, has identified three levels of alliances within their large, open social network. Males tend to form pairs and trios that aggressively court females and then keep those females under close guard. Some of these pairs and trios are remarkably stable relationships that can last for decades. Males are also members of larger teams of 4 to 14, which Connor dubs second-order alliances. These teams come together to steal females from






other groups and defend their own females against attacks, and they can remain intact for 16 years. Connor has observed even larger, third-order alliances that coalesce when there are big battles between second-order alliances.

Two dolphins can be friends one day and foes the next, depending on which other dolphins are nearby. Primates tend to have a “you’re either with us or against us” mentality when it comes to making distinctions within and between groups. But for dolphins, alliances seem

to be situational and extremely complicated. The need to keep track of all those relationships may help explain why dolphins possess such large brains.

Dolphins are also among the most cosmopolitan animals on the planet. Like humans on land, dolphin species are seemingly everywhere in the sea, and like humans, they have proved ingenious at discovering feeding strategies that are particular to the environments they inhabit. In Shark Bay some bottlenose dolphins detach sponges from the seafloor and place them on their beaks for protection while searching the sand for small hidden fish—a kind of primitive tool use. In the shallow waters of Florida Bay dolphins use their speed, which can exceed 20 miles an hour, to swim quick circles around schools of mullet fish, stirring up curtains of mud that force the fish to leap out of the water into the dolphins’ waiting mouths. Dusky dolphins off the coast of Patagonia herd schools of anchovies into neat spheres and then take turns gulping them down.

All these behaviors have the mark of intelligence. But what is intelligence really? When pressed, we often have to admit that we’re measuring how similar a species is to us. Kuczaj thinks that’s a mistake. “The question is not how smart are dolphins, but how *are* dolphins smart?”



Dolphins are extraordinary problem solvers. These two bottlenose dolphins off the Florida Keys quickly learned that the only way to pull the cap off a PVC pipe filled with fish was to cooperate.

There are people who go on spiritual retreats to commune with dolphins, women who choose to give birth in the presence of dolphins, and centers that claim to use the powers of dolphin energy to treat the sick. “There are probably more weird ideas about dolphins swimming in cyberspace than there are dolphins swimming in the ocean,” writes Gregg. Many of those weird ideas can be traced back to a single man, named John Lilly.

Lilly was an iconoclastic neurophysiologist at the U.S. National Institute of Mental Health who began studying dolphins in the 1950s. In best-selling books like *Man and Dolphin: Adventures on a New Scientific Frontier* and *The Mind of the Dolphin: A Nonhuman Intelligence*, he was







In Florida Bay bottlenose dolphins have invented a unique way of capturing mullet fish, by encircling them with curtains of whipped-up mud. When the fish leap over the mud rings to escape, they land in the waiting mouths of other dolphins.

PHOTOGRAPHS ON THESE PAGES AND PAGES 30-31 AND 55 WERE PRODUCED UNDER NMFS PERMIT #17941

Having scanned the ocean bottom with echolocation to find hidden fish, a dolphin off the coast of Bimini in the Bahamas goes vertical, digging the fish out of the sand with its rostrum, or beak.





the first scientist to posit that these “humans of the sea” had a language. Almost single-handedly, writes Gregg, he “managed to transform what was initially regarded as an odd air-breathing fish at the turn of the 20th century into an animal whose intelligence is so sophisticated that it deserves the same constitutional protection as you or me.”

With grants from major scientific funding bodies, Lilly opened a dolphin research facility in the U.S. Virgin Islands, where attempts were made to teach a dolphin named Peter to speak English. As the 1960s dawned, Lilly’s experiments grew more and more unconventional—at one point he injected dolphins with LSD—and his funding began to dry up. He wandered off

by word, Akeakamai could interpret her instructions only after she’d seen the entire sequence of gestures. Swimming in a pool filled with objects, the dolphins would carry out their instructions correctly more than 80 percent of the time.

After Akeakamai died in 2003 and Phoenix in 2004, their ashes were taken out to sea on surfboards and scattered, and the only research facility in the world dedicated solely to understanding how dolphins think went out of business. A big question remained: Why had Phoenix and Akeakamai found it so easy to learn the languages? Herman dismisses any notion that the researchers were piggybacking on some innate linguistic capacity. In his view, the imposed languages had allowed Phoenix

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## **They’re a kind of alien intelligence sharing our planet—watching them may be the closest we’ll come to encountering ET.**

into the weirdest corners of the counterculture and carried with him the credibility of the field he’d helped create. Dolphin “language” would become an untouchable subject until 1970, when a University of Hawaii psychologist named Louis Herman founded the Kewalo Basin Marine Mammal Laboratory in Honolulu.

“We wanted to educate them to reveal their cognitive potential,” says Adam Pack of the University of Hawaii at Hilo, who worked at the lab for 21 years. “We reared the dolphins as you would a child.”

At Kewalo Basin two captive bottlenose dolphins, Phoenix and Akeakamai, were raised in an environment of constant education and schooled in an artificial language. Both were taught to associate either sounds or hand signs with objects, actions, and modifiers.

But Phoenix was taught an acoustic language in which words were placed in the order of the tasks to be performed. Akeakamai was taught a gestural language in which the order of the words was not the same as the order of the tasks. Though Phoenix could in theory respond word

and Akeakamai to express exceptional cognitive abilities common to all bottlenose dolphins—and perhaps other dolphin species—in a way that might never be exhibited in the wild. But is there some native form of dolphin communication that humans could eavesdrop on and eventually understand?

It turns out that there’s strong evidence to suggest that at least one kind of dolphin sound, studied extensively over the past decade, does function as a kind of referential symbol. Dolphins use distinct “signature whistles” to identify and call to one another. Each dolphin is thought to invent a unique name for itself as a calf and to keep it for life. Dolphins greet one another at sea by exchanging signature whistles and seem to remember the signature whistles of other dolphins for decades. Though other species, like vervet monkeys and prairie dogs, make sounds that refer to predators, no other animal, besides humans, is believed to have specific labels for individuals.

Signature whistles are only some of the vocalizations dolphins make underwater. What

are the chances that they're the only sounds in the dolphins' repertoire that refer to something? How likely is it that dolphins have names only for each other and not for anything else in the sea?

**A** veritable Jane Goodall of the sea, Denise Herzing has spent the past three decades getting to know more than 300 individual Atlantic spotted dolphins spanning three generations. She works a 175-square-mile swath of ocean off the Bahamas, in the longest running underwater wild-dolphin program in the world. Because of its crystal clear waters, it's a place where dolphin researchers can spend extended periods observing and interacting with wild animals.

Last summer I joined Herzing aboard her research boat, the R.V. *Stenella*, as she was preparing to run her first live trials with a complex new piece of machinery that she hopes will someday enable two-way communication between herself and the dolphins she has spent so long getting to know—and along the way illuminate how they communicate among themselves.

dolphin-like whistles, the computer can convert the sound into words and then play them through a headset in Herzing's ear.

Dolphins are notoriously talented mimics and quick students. Herzing's goal is to get a handful of juvenile females she has known since birth to associate each of three whistle sounds broadcast by the CHAT box with a specific object: a scarf, a rope, and a piece of sargassum, a brown seaweed that wild dolphins use as a toy. Those three "words," she hopes, will form the rudiments of a growing vocabulary of whistles shared by her and her dolphins—the beginnings of an artificial language in which she and they might someday be able to communicate.

"Once they get it—like Helen Keller getting language—we think it's going to go very rapidly," Herzing says. "Because they're social, we're capitalizing on other individuals watching. It's like kids on a playground."

Herzing, 58, is buoyant and optimistic, the kind of person for whom the word "visionary"—with its implications of both genius and kookiness—seems fitting. When she was 12 years old, she entered a scholarship contest that required her to answer the question "What

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## Dolphins use distinct "signature whistles" to identify one another. No other animal, besides humans, is believed to have specific labels for individuals.

That piece of machinery is a shoebox-size cube of aluminum and clear plastic known as CHAT (cetacean hearing and telemetry), which Herzing wears underwater strapped to her chest. The 20-pound box has a small speaker and keyboard on its face and two hydrophones that look like eyes sticking out below. Inside, amid a tangle of wires and circuit boards sealed off from the corrosive effects of seawater, is a computer that can broadcast dolphins' prerecorded signature whistles as well as dolphin-like whistles into the ocean at the push of a button and record any sounds that dolphins whistle back. If a dolphin repeats one of the

would you do for the world if you could do one thing?" Her reply: "I would develop a human-animal translator so that we can understand other minds on the planet."

In her underwater sessions, face-to-face with dolphins, sometimes for hours at a time, Herzing has recorded and logged thousands of hours of footage of every kind of dolphin behavior. She has also assembled a huge database of her loquacious subjects' vocalizations.

Aboard the *Stenella* was another notable scientist, Thad Starner, a professor of computing at Georgia Tech. A pioneer of wearable computers, he's also a technical lead at Google, where he





An orca, the largest dolphin, thrusts itself onto the beach at Punta Norte, Argentina, to grab a sea lion pup. This risky behavior—orcas occasionally become stranded—is passed down from mothers to calves and is found in just a few locations.

works on Glass, the heads-up display that allows wearers to access the Internet as they go about their day.

Starner, 45, is boyish, with curly blond hair, wide eyes, and bushy sideburns. He wears Glass pretty much all the time and takes notes with a lemon-shaped keyboard that's strapped to his left hand and fits in his palm. Starner's lab team fabricated the CHAT box, and he's come aboard the boat for ten days of technical testing and data collection.

If the mysteries of dolphin communication are ever to be cracked, it may have less to do with the two-way CHAT boxes than with the data-analysis tools Starner and his students have begun applying to Herzing's dolphin recordings. They're designing an algorithm that systematically searches through heaps of uncategorized data to find the fundamental units hiding inside. Feed in videos of people using sign language, and the algorithm pulls the meaningful gestures out of the jumble of hand movements. Feed in audio of people reading off phone numbers, and it figures out that there are

11 fundamental digits. (It's not smart enough to realize that "zero" and "O" are the same number.) The algorithm uncovers recurring motifs that might not be obvious and that a human might not know how to look for.

As an early test of the algorithm, Herzing sent Starner a set of vocalizations she'd recorded underwater without telling him that he was listening to signature whistles sent between mothers and calves. The algorithm pulled five fundamental units from the data, which suggested that signature whistles were made up of individual components that were repeated and consistent between mothers and calves and that might be recombined in interesting ways.

"At some point we want to have a CHAT box with all the fundamental units of dolphin sound in it," says Starner. "The box will translate whatever the system is hearing into a string of symbols and allow Denise to send back some string of fundamental units. Can we discover

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Fieldwork was partially funded by Hussain Aga Khan and his organization, Focused on Nature.

the fundamental units? Can we allow her to reproduce the fundamental units? Can we do it all on the fly? That's the holy grail."

**W**hen the opportunity finally arrives to test the CHAT box in the wild, it's not just any dolphins that show up at the bow of the *Stenella*.

The two dolphins that swim up to the boat are ones that Herzing has been hoping to encounter all week: Meridian and Nereide. Indeed, recordings of both dolphins' signature whistles have been preprogrammed into the CHAT boxes in the hope that Herzing might get a chance to greet the dolphins and interact with them. It's almost as if they've come to find us rather than the other way around.

Herzing has known most of her dolphins since birth, and she knows their mothers, aunts, and grandmothers as well. Many readers of this magazine know one of them too: Nereide's mother, Nassau, appeared on the cover of *National Geographic* in September 1992, swimming beneath the surface of the same Bahamian waters.

These two females represent the best candidates for Herzing's work. They haven't yet become pregnant and are still just kids, with lots of curiosity and lots of freedom to play and explore. Sexual maturity in female Atlantic spotted dolphins arrives around age nine. Their life span can be more than 50 years.

When Herzing dives into the water and plays Meridian's signature whistle for the first time, the dolphin turns and approaches, though without any outward sign of the surprise one might expect from a creature that's just heard its name called by another species.

Herzing swims with her right arm stretched out in front of her, pointing at a red scarf she has pulled out of her swimsuit. She repeatedly presses the button for "scarf" on the CHAT box. It's a rolling chirp that dips low and ends high, lasting about a second. One of the dolphins swims over, grabs the piece of fabric, and moves it back and forth from its rostrum to its pectoral fin. The

scarf ends up hanging from the dolphin's tail as she dives down to the bottom of the ocean.

I'm in the water with Herzing, trailing a few feet behind her with a graduate student who's recording the encounter using an underwater camera. I keep waiting for one of the dolphins to take off with the scarf, but neither of them does. They seem to want to engage us, however tentatively. They pass the scarf back and forth, circle around us, disappear with it, and then offer it back to Herzing. She grabs it and tucks it back into her swimsuit and then pulls out a piece of seaweed. Nereide swoops down to grab it between her teeth and starts to swim off. Herzing takes off after her, pressing the CHAT box's sargassum whistle again and again, as if desperately asking for it back. But the dolphins just ignore her.

"It's not inconceivable that if the dolphins understand that we're trying to use symbols, that they would try to show us something," Herzing says later, back on board the *Stenella*. "Or imagine if they started using our word for sargassum amongst themselves."

For now that still feels like a distant dream. The CHAT box never registers any mimicking during this hour-long encounter. "It's all about exposure, exposure, exposure," says Herzing. A tall order when you're a human on a boat trying to link up with wild dolphins for a brief chat in a vast ocean.

"They're curious. You can see them starting to put it together. I just keep waiting for them to trigger," she says. "I keep waiting to hear a female voice in my headphones saying, 'Scarf!' You can almost see them calculating in their eyes, trying to work it out. If only they'd give me some acoustical feedback."

The feedback may be there, just not in a form anyone can make sense of yet. Nereide had draped the sargassum over her tail as she floated casually through the water, finally shaking it off and then blowing a big, playful bubble.

After an hour in the water with us, the dolphins began to lose interest. As Nereide turned to leave, she made one final long, mysterious whistle, looked back at us, and then swam off into the blue darkness and disappeared. □





Spinner dolphins off Kona, Hawaii, spend a morning adorning themselves with leaves. Play is an important part of the social lives of dolphins and is believed to be crucial to their cognitive development.



**Shyra Jones**, an autoworker, joins thousands of Detroiters at the Slow Roll, a weekly ride on roads left less crowded after more than half the population moved out. Built for many more cars than are there now, the city has become bike friendly, adding 150 miles of dedicated lanes.





# Taking Back Detroit

*With the nation's biggest urban bankruptcy in the rearview mirror, the Motor City and birthplace of Motown finds itself suddenly cool again. Tough, real, and cheap, it has plenty of empty space to fuel any imagination.*

*By Susan Ager*

*Photographs by Wayne Lawrence*

**I**n the heart of Detroit, America's poorest big city, Anthony Hatinger is planting seeds in a reclaimed liquor store, a squat building repainted in Disney colors: supersize white fish swimming through happy green reeds in deep blue water.

Wearing a tie-dyed T-shirt and a gray knit cap, bathed in the glow of greenhouse lights, he holds a pen cap, maneuvering its pointy end to scoop three tiny basil seeds from his palm. He drops them onto moist, cakey plugs of soil—"brownie bites," he calls them—as he works to give them the potential to sprout.

The sweet Italian basil will grow alongside a variety of lettuces. Downstairs, where liquor was once stored, thousands of baby tilapia swim in vats. Their waste, pumped upstairs, feeds the greens, which absorb the nutrients. The water, thus filtered, flows back down to float the fish. The cycle continues.

Once, Kory's Market was a fixture in this north-central neighborhood, five miles from downtown and not yet on the go-to map in a long-derided city that improbably finds itself cool. Tough, real, and cheap, Detroit, with the nation's largest municipal bankruptcy behind it, is suddenly attractive to investors, innovators, and would-be fixers, especially young adventurers.

Hatinger, who's 25 and has a black mother and

**Kenneth Morgan**, a Gulf War veteran, returned to Detroit four years ago after 30 years away. He left when he was nine years old, traveling the world with his military father, but chose to settle his family in Detroit because, he says, "it's home. There's no place like home." Morgan, his wife, Robin, and their children, Gary Effler and Kenneth D. and Korey Morgan, are renovating a duplex they bought on the East Side for \$1,800 plus back taxes. "I figure if I can fight for my country, I can definitely fight for my city."















*“It’s like the California gold rush here. But if we are careful and selective, we get to save neighborhoods, and how cool is that?”*



**Aamir Farooqi**, a retired executive from Singapore, and a partner have bought 150 homes, some for as little as \$500. They rehab and rent them. He bought his own “slowly decaying” home from a man who had owned it for half a century. Farooqi hired workers to restore it who sanded every stairway spindle and peeled yellow paint from the fireplace surround of Pewabic tiles, classic to Detroit. “If you’re going to be invested in Detroit, you better have your own money. Then you have skin in the game.”

a white father, is a quiet part of that change. A newcomer from central Michigan with a degree in religious studies and a minor in horticulture, he is thrilled to be working for a Christian community development agency helping to change Detroit from the ground up. The fish and greens feed customers at busy new eateries as well as low-income, longtime residents at local markets.

On the day Hatinger was in Detroit to interview for what sounded like a dream job, a gunman took a family hostage in the neighborhood. “We have a shooter on the roof!” he heard on his cabbie’s radio. He wasn’t deterred.

Every day he walks or cycles past decay and rebirth: homes collapsing, homes being rebuilt, and empty lots where homes have been carted away. “Detroit has taught me a lot about the spirit, about perseverance,” he says. “It’s incredible to hear some of the stories of people who’ve continued to try to make it work. The heart is so present here. This is the place to be. There’s tremendous need, and tremendous opportunity, in land, in structures, and in spirits—a lot of opportunity to transform.”

LET ME INTRODUCE YOU to a few Detroiters I encountered when I returned to the city where I was born and worked for 25 years. After we moved away, for several years we kept a small condo there, overlooking the Detroit River. In the same way you never forget your mother, your heart never leaves your hometown.

I did not seek out Mike Duggan, the energetic new mayor and the first white one in four decades in the largely black city. Or the leaders of businesses and foundations that donated hundreds of millions to help free Detroit from bankruptcy. Or multibillionaire Dan Gilbert, Detroit’s sugar daddy, who founded Quicken Loans, the nation’s largest online mortgage lender. Gilbert moved Quicken to his hometown, bought more than 70 properties (mostly downtown and ripe for rehab), seeded dozens of start-ups, and employs an estimated 12,500 people.

My curiosity was not about the mighty directors of this unfolding drama but the small players who are creating a new city out of what

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*Susan Ager wrote for the Detroit Free Press for 25 years. Wayne Lawrence published a monograph on New York City’s Orchard Beach in 2013. This feature is each one’s first for the magazine.*







*“I think that  
once they get  
everything  
together as far  
as the finances,  
Detroit will  
be back on the  
map, bigger  
and better  
than ever.”*

**Shervette Michelle Stanford** celebrated her 46th birthday at Bert's Market Place, a jazz club in the Eastern Market neighborhood, by singing karaoke selections from Gladys Knight and Whitney Houston. She moved to Detroit as a child when her family home was lost in the 1971 southern California earthquake. She insists that Detroit doesn't deserve its bad rap. “It's my city. You can enjoy yourself. Detroit is beautiful.”

was long dismissed as a wasteland. Some moved in with solid plans; some nurse airy dreams; some subsist on fortitude. Others pray that their candles, so far from the changes, might somehow catch a spark. Detroit's decay is now its engine: Nowhere else in urban America can you do so much with so little money.

The new Detroit shines downtown. Nearby areas like Corktown and Midtown radiate energy. But around this incandescence skulks the old Detroit, acres of decay and ruin, prairies where the remaining houses stand aloof from each other. The plants that made the vehicles that built this town shed chunks of graffitied concrete. Glass is gone from a million windows, like eyes absent from faces.

I ricocheted from high hopes to despair. But the Detroiters I met, almost to a one, have faith in even an uncertain future. Indeed it's what defines them. Those who couldn't summon hope left long ago, if they could.

IT'S POSSIBLE TO DRIVE to downtown Detroit without confronting the still crippled Detroit. The city's freeways are sunken, hiding its plight, the departure of more than half its peak population. Robert Hake did just that for months after he moved his growing custom sportswear company from the suburbs to the city's Corktown neighborhood. Called MyLocker.net, it can ship a hundred hoodies for your family reunion in days. “My decision had nothing to do with reviving Detroit,” he tells me from behind his shiny, ten-foot desk, which reflects the skyline. Instead he'd snagged a good deal—an empty auto parts factory the size of two football fields. “But,” he says, “now that I'm part of it, I'm being drawn in.”

Hake, 41, overcame what he admits were deep doubts. Detroit was called Murder City U.S.A. in the 1970s for a reason. He recalls the trepidation he felt as a suburban kid riding into the city, when his parents warned: “Roll up your windows and lock your doors.”

Excited by the city's new effervescence, he searched Google for graffiti artists, interviewed several, hired one, and gave him a key and instructions: “Do whatever you want, wherever you want, whenever you want.” The walls are adorned with icons of Detroit, from Faygo soda pop to boxer Joe Louis's fist. He's hiring locally, adding 70 Detroiters to almost double his full-time staff.

One morning Hake, who still lives in the

suburbs, drove outside his comfort zone, onto streets that stretch like worn threads between the freeways. He hauled 400 colorful T-shirts designed by his staff to donate to an elementary school. On the ten-mile drive, he passed street after street of broken-down houses. At the school, though, “I found hallways full of happy, innocent, beautiful children,” he says. “It was heartbreaking to know that those children lived on those streets.”

He thought: How blind I have been. I should give a T-shirt to every kid in Detroit.

Robert Hake is emblematic of what’s happening in this once forlorn city. It is reinventing itself, building by building and idea by idea but, as important, person by person. More tangibly, freed from about \$18 billion in debt, the city has money to do some of what needs to be done. It has replaced about 40,000 streetlights ruined by scrappers and time. Police response time has shrunk from almost an hour to less than 20 minutes. And roughly a hundred ramshackle homes are crushed each week.

FROM HIS STUDIO a few blocks from MyLocker, Antonio “Shades” Agee, the graffiti artist who’s painting it, isn’t surprised that Hake only recently discovered Detroit’s gloom. It’s easiest to stay on the city’s bright side.

Agee grew up in Detroit. His Hispanic mother still lives in his childhood home, now one of the few on the block, in a neighborhood he doesn’t like to visit. It’s not “the new Detroit.” Nor was Black Bottom, Detroit’s vibrant Harlem, where his father played jazz. It was bulldozed in the 1950s for redevelopment and a freeway.

At 44, he is trim from biking; he rarely drives. His right arm—“my painting arm”—is densely tattooed. From the multi-tinted panes of his loft in a former paintbrush factory, Agee has watched Corktown change. He’s a regular at the Detroit Institute of Bagels, just below his window, built for a cool half million dollars. “It still blows my mind to see a girl running down the street and she’s not being chased,” he says.

He’s genuine Detroit—gutsy, driven, growing up when he had to “find water in a cactus.” He says, “Detroit has originality because we don’t have any distractions.” At 15, he was drinking and drugging and tagging. Woodward Avenue, Detroit’s main street, now aglitter with shops and condos, “was so dead I (Continued on page 71)







A revived downtown is ringed by neighborhoods that have seen severe population decline since the 1950s and are increasingly being replaced by green space. Many of the more stable areas are at the far edges of the city, abutting the suburbs.

ALEX S. MACLEAN, NEW YORK TIMES/REDUX





# Rethinking Detroit

In less than five decades the once vibrant Motor City lost more than half its population and gained a reputation as a failed metropolis of abandoned buildings, widespread poverty, and rampant crime. But photos of derelict homes and empty lots can create a misleading impression. The city ranks 69th in population density—people per square mile—among U.S. cities with more than a hundred thousand people, ahead of Las Vegas, Denver, Phoenix, and Portland, Oregon, to name just a few. Detroit is still losing inhabitants, but neighborhoods such as Woodbridge are rebounding.

MARTIN GAMACHE AND KELSEY NOWAKOWSKI, NGM STAFF  
SOURCES: NOAH URBAN, DATA DRIVEN DETROIT; LOVELAND TECHNOLOGIES;  
DETROIT LAND BANK AUTHORITY; SOUTHEAST MICHIGAN COUNCIL OF  
GOVERNMENTS; COMMUNITY DEVELOPMENT ADVOCATES OF DETROIT; MOTOR  
CITY MAPPING; OPENSTREETMAP; U.S. CENSUS BUREAU; CITY OF DETROIT  
ASSESSMENT DIVISION AND PLANNING AND DEVELOPMENT DEPARTMENT; NOAA

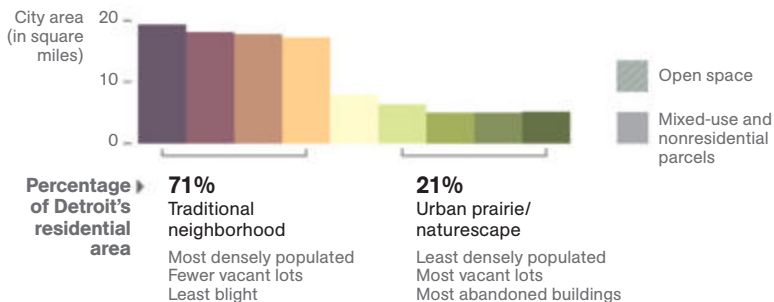




- 1 Hamtramck and Highland Park are incorporated cities completely surrounded by Detroit. Historically Polish Hamtramck has the third largest Bangladeshi population in the U.S.
- 2 Construction is starting on the privately and publicly funded 3.3-mile M-1 Rail streetcar project. It will connect downtown Detroit to the bustling Midtown commercial district.
- 3 Investor interest in Detroit's downtown is growing. Residential occupancy rates are high, and two local investors have bought and are developing more than 130 properties here.

## Block by Block

Many neighborhoods along Detroit's perimeter are as densely populated as the city's wealthier suburbs. This analysis at the block level shows the range from neighborhoods that are thriving to those that have more vacant lots—and to areas reverting to nature, known as “urban prairie.”



# Detroit Up Close

Detroit's population plummeted, in part due to the growth of the suburbs in the 1950s, race riots in 1967, the decline in auto manufacturing, and the 2008 financial crisis. Over the decades each neighborhood has responded



**Sherwood Forest**

This northern neighborhood has long been stable. It's near a university and golf course and abuts other strong neighborhoods. The more than 500 brick homes in this predominantly middle-class, black



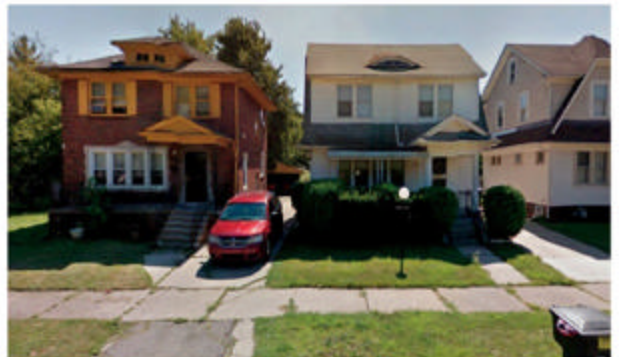
**Woodbridge**

Many affluent residents left for the suburbs after World War II, but this community of mostly Victorian homes has seen an influx of young professionals since housing incentives began in 2011. City organizations have



**Burbank**

Population loss in this part of the city has been staggering. Hit hard by the mortgage crisis, Burbank lost 41 percent of its residents from 2000 to 2010. Of the neighborhood's 7,300 properties, only 3,000 are occupied and



PHOTOS: GOOGLE MAPS STREET VIEW. FROM TOP:  
AUGUST 2013, OCTOBER 2014, SEPTEMBER 2013



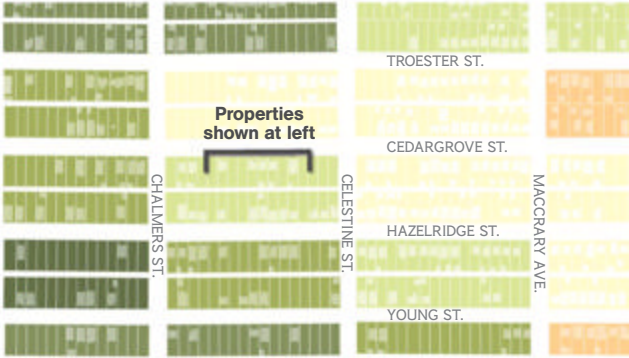
differently to the many shocks to Detroit's economy. Some neighborhoods have remained intact and vibrant; others are now being revitalized. Some have fallen so far they are approaching the point of no return.



community are in good condition. Eight homes are unoccupied, and 33 lots are vacant. Sherwood Forest has not suffered the exodus other neighborhoods have faced in recent decades.



targeted the neighborhood, within walking distance of downtown and the future M-1 streetcar, for improvement. More than half its 1,200 properties are vacant lots. About 60 houses were unoccupied, but that number continues to decline.




2,350 are vacant lots. Nearly 200 of its mostly postwar, lower quality homes have been recommended for demolition, and 340 homes have fire damage, mostly likely related to high rates of arson and vandalism in Detroit.











*“The question is: How do we protect the people most vulnerable around us as we change the city and make it better?”*

**Shanika Owens** and **Jasmine Moore** are first-year Wayne State law students. The two joined a hundred classmates in a service project with the Michigan Urban Farming Initiative, helping weed, garden, and pick up trash in a Midtown neighborhood. Both Detroiters intend to stay in the city, using their degrees to improve its civic life, perhaps as judges. Owens, quoted above, decided to go to law school so she could “learn the rules of the game” for how the city works.

could paint a wall and nobody would care.” Agee transcended the streets. His clients include Reebok, Quicken, and Fiat Chrysler, and even white suburbanites: He painted a grand piano with feel-good slogans and his signature giant lips.

He knows he’s part of a now popular brand, a Detroit that’s tough, resourceful, proud. He resents that the brand has become a talisman for people who hardly know Detroit but boast its name on their shirts. “This big flourishing,” he says, “it’s great! I love it. But most people, they wanna save Detroit. You can’t save Detroit. You gotta *be* Detroit.”

ONCE DETROIT WAS the Paris of the Midwest, with its broad river, grand boulevards, and historically significant architecture. It became the Motor City, assembling most of the world’s automobiles, and the Arsenal of Democracy, manufacturing World War II armaments. Steady work and union wages meant an autoworker could own a home, plus a boat, maybe even a cottage. Some say America’s middle class was born in Detroit, but Motown most certainly was.

New freeways lured some Detroiters to the suburbs in the late 1950s, but devastating race riots in 1967 scared away tens of thousands, mostly white families. Detroit has been predicting rebirth ever since, starting a year later, when the Detroit Tigers beat the St. Louis Cardinals in the World Series.

I remember, because I cut out articles about the riots and the baseball games, gluing them into scrapbooks. I lived in suburbia, where my parents moved in 1957 when I was three, at the edge of a slow wave that would sweep away more than half the city’s population. But my heart lived in Detroit, where Grandpa Zielinski grew roses and garlic, and Grandma walked with me to Polish bakeries for pumpernickel bread. I sang along with the Supremes. I shared my Christmas wishes with Santa at J. L. Hudson’s, a department store that filled a city block and was then the world’s tallest at 25 stories.

Rebirth looked promising again when, in the 1970s, the grandson of Henry Ford erected the majestic towers of the Renaissance Center, dubbed the RenCen. Built like a fortress, it repelled visitors. A 2.9-mile elevated People Mover, inaugurated in 1987, was going to revitalize downtown; hardly anyone rode it. Three

casinos opened in 1999 and 2000; they weren't the answer. Hosting the 2006 Super Bowl was supposed to be a tipping point. It wasn't.

The gusts that finally collapsed the sagging city were the bankruptcy of General Motors and Chrysler, and the foreclosure crisis that began in 2008. Abandoned houses and schools attracted looters, drug dealers, and delinquents giddy for fire. What had been a tidy quilt of neighborhoods, with single-family homes and hardware stores, finally fell into scraps.

Nobody is talking about rebuilding the whole 139-square-mile city, huge enough to fit Manhattan, Boston, and San Francisco. But

it, four more homes, and four condos. "We're pretty tapped out now," he says, "at \$150,000." His \$8,600 house had been abused: windows and appliances missing, wiring and pipes ripped out, oak floors sodden with trash and rotting food. Having put about \$15,000 into the house, all that is behind him. He painted its plaster walls a soothing pale denim. In the yard he built raised beds and installed a beehive.

"I feel really good about this city," he tells me over green tea, a fire warming the living room. "The people here are the roots of its potential." What's more, his mother will move into the house next door. A flight attendant near retirement,

# "You can't save Detroit."

like a fading migraine, the mood of the city has lifted. In its mere solvency, Detroit feels flush.

AT THE FAR EASTERN EDGE of the city, Alex Badasci Lindmeier, 36, owns his first home: a 90-year-old brick Tudor so near the river he can hear the moaning horns of passing freighters.

Lindmeier and his girlfriend had almost dropped \$300,000 for a studio condo in her hometown of Hong Kong, then realized, "We'd spend all our money, and it wouldn't bring us anything new or exciting." He designs websites; she does online marketing. They can do their jobs anywhere, so began to look all over: up and down the West Coast, including his home state of California, and even in Las Vegas.

In Vegas in July 2013, on the brink of making a bid for a house, Lindmeier heard on his car radio that Detroit had filed for bankruptcy. He learned its old houses were being torn down. Within days he packed a suitcase, an ice chest, and his black lab mix, Maya, and drove across the country. From a Motel 6 he made daily excursions into the unfamiliar landscape, living off ham-and-cheese tortilla wraps.

One day he happened upon a block party in the Jefferson Chalmers neighborhood: people of all shades savoring a barbecue. Within weeks he started buying, and within a year, owned an abandoned house on that block, the lot next to

she bought the last rough house on the block, for \$5,000. She's eager for a grandbaby.

A FEW BLOCKS FROM where Hatinger plants seeds, Ruth Lowe can see the changes up close. On her block, every house but hers is being torn down or rehabbed. She might be 90, but she knows the exact date she moved into the sturdy brick duplex with her grandmother, mother, husband, and two children: November 22, 1957.

We sit tight together in her foyer, where she reads mail and watches TV. She apologizes for the flowered scarf she hastily threw over her hair after I knocked. When I ask how she feels about Detroit these days, she stresses each word: "I ... am ... overjoyed." She jokes that her house, the nicest on the block, might soon be the shabbiest. "For too long," she says, "nobody's been sitting out on their porches but me."

Once, she knew the city intimately, waiting tables at a black-owned hotel, and later selling insurance. Lowe has stayed in this house, with its oak trim and beveled glass, because it was paid for long ago and holds her family's history. Now it shelters her unemployed grandson; one daughter comes and goes. A few months ago that daughter's car and the replacement rental were stolen from the curb out front.

"I tell my kids, Don't let this house down



when I'm gone," she says, because she's confident for its future (if only she could get her sidewalk fixed). "I won't be here to see it, but Detroit's coming back. It's gonna be world-class, a little New York."

ERIKA BOYD, 41, and Kirsten Ussery-Boyd, 36, are catalyzing change in West Village, four miles from Lindmeier. Their cheery, 34-seat restaurant, Detroit Vegan Soul, was the first business in a long time on a dark, soulless street.

When the married couple became vegans, they each lost 20 pounds and decided that their city, one of the fattest in the country, could

"In Detroit, you can contribute, and your ideas are met with enthusiasm. It's thrilling. If someone else had my life, I'd be jealous. I moved here with \$500, and six months later I was the owner of a successful business." Another refugee from Brooklyn traded a 70-hour workweek and a tiny room for part-time work and a cozy, if shabby, three-bedroom house. "Detroit offers space and time," she says. "Here there's maybe a chance for young people to build a middle class."

One morning getting coffee, I learn the woman at my side is visiting from Austin. Emboldened by all that youthful excitement, I say, "You know, Detroit is the new Austin." She replies,

# You gotta *be* Detroit."

—Antonio "Shades" Agee

benefit too from southern-fried tofu. "Detroiters need this," Ussery-Boyd says.

Unable to get a loan, they scraped up about \$45,000 to open the restaurant, painting its walls appetizing colors of avocado, cashew, and sweet potato. It's a family affair. Boyd's mother trains staff and coordinates catering. Ussery-Boyd's mother bakes vegan cakes weekly.

Within blocks now are a coffee shop, a high-end restaurant, a tea-and-tarot shop, and more. But, says Boyd, the chef, "in this whole slew of new businesses, I'm the only native Detroiter." The women see other black Detroiters stepping up. Ussery-Boyd says, "Finally the lightbulb is going off: We shouldn't leave. We should be part of this."

I AM GRATEFUL TO SEE money finally flowing in to rescue my hometown. It's mostly white money, but—despite a lingering tangle of racial and class resentments—it appears that Detroiters, down so long, mostly don't care. Money can fertilize growth.

The young coming to Detroit, some with money, some to make it, are seeding and fertilizing too. These millennials, many from hip, pricey places, sound almost giddy to me.

A waiter from Portland, Oregon, blesses Detroit's challenges as "part of its charm." A newcomer from Brooklyn who converted an empty hair salon into a busy market tells me:

"That's good, because Austin is full up. Just like Portland. And San Francisco before that."

JOHN HANTZ MADE A FORTUNE in financial services in the suburbs. He's a reserved fellow who, at 53, loves chopping wood, smoking cigars, and living alone in a 14,500-square-foot home in Detroit's historic Indian Village, "mostly in my kitchen and bedroom," he says, "just like you."

But he's also a visionary. Unlike others, eyeing cheap structures, Hantz saw the possibilities in empty space. For years, he says, "I lied to myself—it's gonna get better—along with a million other people." One day, on his commute past the ruins, he thought: Let's not talk about collecting the trash, mowing the lawns, and tearing the houses down. Let's man up. Why not put in trees that ask so little and give so much?

It took almost five years of wrangling with the city. Opponents accused him of being an imperialist disguised as a do-gooder, with vague plans for distant profits. Last year he finally was able to buy 1,350 city-owned properties, plus 450 others, scattered over a one-square-mile area on the lower East Side. He cleared 500 lots, including more than 2,000 tires, and with 1,400 volunteers, planted 15,000 trees. The four million dollars he has spent, he says, already pays him "psychic income."

Most of his trees are saplings that look like

yardsticks. But on several lots he planted 30-foot sugar maples so neighbors could imagine the future. With that, says Hantz, “we saw the pride open up like a flower.”

BUT PRIDE AND TREES are not enough. The city still struggles to provide the most basic services, such as on-time buses, speedy police and fire responses, and lighting.

The problem is so basic but so daunting: Many of Detroit’s people are poor and widely dispersed. In 1950 the city housed 1.8 million people, about 84 percent white. By 2013 its population had fallen to 689,000, about 83 percent black. Half its households live on less than \$25,000 a year.

Newcomers tweet about music and cocktails, but crime and lousy schools remain serious obstacles to a sustainable recovery. Homicides are falling, but among cities with a hundred thousand people or more, Detroit still tops the nation for violent crime. The city’s schools, called “a national disgrace” by the U.S. education secretary, are a target for improvement by civic leaders.

Once, men and women flocked to Detroit from the cotton fields of the South for well-paying automobile factory jobs. My grandfathers—one a fourth-grade dropout—came from the steel mills and coal mines of Pennsylvania to establish us for generations as a “Ford family.” Blue-collar jobs can still be had in the city’s three remaining auto plants, but most require advanced skills. Scores of tech start-ups in the new city do too. That leaves Detroit with a big obstacle to its rebound: the highest unemployment rate among the nation’s 50 largest cities.

EVERY WEEK, IT SEEMS, a new business opens in Detroit—grocery stores, juice bars, coffee shops, even bicycle makers. The only thing new about Robert “Lil Grady” Long’s business is its light-bulbs. He came back to Detroit to take over his late father’s Grand River Avenue barbershop. “I gave up my little factory job in Toledo,” he says, “and walked out on faith.”

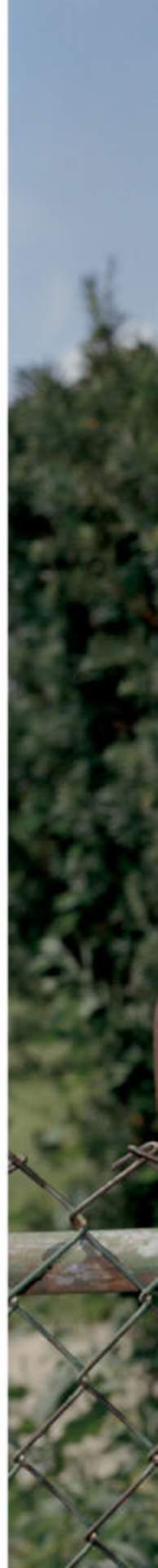
Above the doorway, the name is hand-painted in red, white, and blue: “G n C Barber Style Shop, est. 1964.” A neon “Open” sign is unlit. A “Sorry We’re Closed” sign hangs in one window. But the shop’s metal door, with four locks, is wide open, and customers fill three of the four chairs.

Long considers his central West Side shop a community center. Guys come in to watch TV

*“I definitely think Detroit is on the rise, but it’s gonna take time. It’s not gonna take no one, two, three years. It’s gonna take at least five or more years.”*



**Ronel Pounds**, a native Detroiter, came back after more than a decade in Virginia, working and playing semipro football. He returned for a coveted union job at a construction company with steady work in downtown development projects. Father to two daughters and four stepchildren, he follows a path far different from the one of his youth. “I done sold the drugs, I done toted the gun, but overall I came out on top, man. I’m truly blessed to come out on top, man. Thanks to God.”









**Alex Badasci Lindmeier**, seeking to settle down with his girlfriend, passed up an “awesome” \$300,000 studio condo in Hong Kong, where they were living. “It’s such an overdeveloped place,” he says. “It was hard to find any real opportunities to do anything exciting because there’s so much competition.” Instead he bought and rehabbed a 90-year-old beauty in Detroit for about \$24,000. Despite his fears, he’s seen no crime: “That’s isolated, turf-related, drug stuff.”





**Rebecca Graham**, 99, sits surrounded by portraits of five generations of her family in her Midtown home. She has lived in this house since the 1950s and has seen profound changes in the city, including the National Guard patrolling her street during the 1967 riots that sped up migration to the suburbs. Although her neighborhood is on the upswing due to renewed investment, she misses earlier times when she knew everyone on the block.

or play chess. Kids get free haircuts for good report cards. Long, 60, crosses seven lanes of traffic to scrape weeds from cracks in the sidewalk along where his customers park. "I'm mad at the city," he tells me. "We had bad managers, even fights at city council meetings! The people have to come back together. We have to all pitch in. But the ball is rolling." Even into his shop.

He sought a \$10,000 New Economy Initiative grant. To his amazement, he was one of the 30 winners. He'll add a business to repair clippers, sharpen tools, and shine shoes. "We'll clean athletic shoes too, and sell shoestrings and probably socks, and I'll make it like a boutique," Long says. "Black men my age like nice shoes."

Handsome, with a big, easy smile, he wore his \$300 snakeskin shoes to the awards dinner. When the emcee said, "We want to celebrate not just the start-ups but the been-ups," Long felt proud that meant him.

Last summer he joined Slow Roll, a leisurely bike ride staged every pleasant Monday, sometimes attracting more than 4,000 cyclists. Long shakes his head as he tells me: "I went back about ten times, because every time I did, I felt like a little kid. Things like that tell me the city is growing, that you can bring so many people together with no problems."

OVER DRINKS AT the Savoy Hotel in London, Aamir Farooqi first heard about Detroit's potential and soon after flew in from his home in Singapore. He was astonished to be berated by an airport customs agent who told him he was crazy to invest a dime in the city.

But he did. Farooqi, a 54-year-old Pakistani and a retired top executive of the multinational Cargill, says he has spent his liquid assets to buy with Scott Ord, his Australian partner, 150 homes to refurbish and rent. Plenty of international investors bought rock-bottom properties in Detroit, but Farooqi lives here most of the year. He's fallen in love with it.

He restored a 1908 home in Indian Village and furnished it almost entirely with antiques from a venerable auction house favored by Detroit's elite. It fits Farooqi, a refined man who dresses for business in suits, wing tips, and cuff links. "It's like the California gold rush here," he tells me from his parlor. "But if we are careful and selective, we get to save neighborhoods, and how cool is that?"

The mission so exhilarates him that he encourages others: He gives no-interest loans to

*"Here there's a lot of history nobody knows about. And it kinda sucks. But it's history that nobody else has in the U.S."*

**Eddie Chrzan** (aka Bullethead) was born and raised in Detroit. He gets around the 139 square miles of the city on his bikes. For casual rides he rolls out his Schwinn Sting-Ray, his "lit-up bike." But he dreams of owning a Ford Aerostar van and is a member of the Knights of the Round Table Van and Truck Club. "We're more than a club. We're a family. We watch out for each other. We step up for each other when we need to."











**jessica Care moore** (lowercase by her choice), a poet and activist, moved back to Detroit in 2007 with her ten-month-old son “to get my peace” after leaving a failed marriage. She didn’t expect to stay but felt a connection with the art community and decided “they could use me here.” In her poem “You May Not Know My Detroit” she portrays the struggles and triumphs of residents and asserts: “We may have abandoned homes, but we are not an abandoned people.”





**Antonio Agee**, who signs his graffiti “Shades,” knew Detroit at its worst, when he could vandalize buildings without challenge. Now in demand for his art, he says, “I work at night. I don’t work around people.” His hometown is four square miles of optimism “surrounded by reality,” he says. “We’re building from the inside out. There’s a lot to still be developed. People say Detroit is flourishing. Really? Go on the West Side where my mom lives. You’ll be surprised.”

“young people with the guts and gumption to take risks.” The women of Detroit Vegan Soul got \$5,000, as did a few others. Farooqi’s terms: Don’t pay the money back to him. Pay it forward, to someone else revitalizing Detroit.

ON A SUNNY LATE AFTERNOON, as I’m driving away from downtown, my glance catches the sight of barstools behind a half-open industrial garage door. I discover Two James, whose owners call it the first distillery in Detroit since Prohibition. Its bartenders are lithe and tattooed. Its clients are mostly white. One is Jim Hayden, 60, a Seattle businessman who spends several months a year in Detroit. He says, “I am a fan of comeback stories, like *Rocky*, and Detroit is the greatest *Rocky* story ever told.”

Just blocks away, across a freeway, two workmen on ladders hammer on Steve Johnson’s two-story gray corner house. Johnson, a 50-year-old former construction worker, makes a living as a landlord now. Half his ten units in this area are vacant. He’s owned this house for about a decade but saw it wrecked by bad tenants. He’s replacing busted windows. For the moment, they look out on empty lots and tangled brush.

But Johnson is certain newcomers will arrive soon on this side of the freeway, a once overlooked neighborhood now touted as North Corktown. From here you can see the backsides of some of the hottest new spots in town.

“When I was growing up here, these lots were 50 bucks each,” he remembers, squinting and wiping his forehead with the back of his hand. “For a while you could just claim one. If you fixed it up and cut the grass, the city would give it to you. Now all these lots are bought up.”

He lives 11 miles away in a forsaken northeast neighborhood. “It’s never coming up,” he says. He’s nailing his hope here instead and, like other Detroiters in the fitful drama of rebirth, says, “I’m just trying to hang on to what I got.” □

*“I think Detroit will probably do a comeback.”*

**Vincent Peele**, a former welder and supervisor on a Ford assembly line, works part-time now at a Ford body shop. No matter the occasion, he dresses to impress. “Everybody says they like the way I dress. That’s the way I go. That’s how I used to come out of Ford Motor Company. When I get through doing my work, I go in there and take me a shower and put my suit on, and I get the jump on outta there.”

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PHOTOGRAPHER INTERVIEW

*“Here I am, looking for desolation, blight, and abandonment, and I find life.”*

—WAYNE LAWRENCE










A new honeybee emerges from a brood cell. In her six-week life span, this worker bee will forage for food, make honey—and raise the next generation.

IMAGE COMPOSED OF 23 DIGITALLY MERGED PHOTOGRAPHS  
SOURCE: BILLY SYNK, HARRY H. LAIDLAW JR. HONEY BEE RESEARCH FACILITY, UC DAVIS





*Can the world's most important pollinators  
be saved? How scientists and breeders  
are trying to create a hardier honeybee.*

# Quest for a Superbee





A syringe places a minute droplet of phenothrin on a honeybee—sedated in a paper cup—to test the effects of the potent insecticide in this experiment by Louisiana State University and the U.S. Department of Agriculture. Because honeybees return to hives at dusk, they seldom come in contact with such chemicals, which are usually sprayed at night. But researchers have discovered that even tiny doses can have negative consequences for honeybees.

SOURCE: FRANK RINKEVICH, LOUISIANA STATE UNIVERSITY, BATON ROUGE





This story is part of National Geographic's Future of Food initiative, a special five-year project that seeks to show how what we eat makes us who we are.

Brother Adam must have known he had become a beekeeper at an unlucky time. It was 1915, and he was a 16-year-old novice at Buckfast Abbey in southwest England. Rapid bee die-offs have been recorded for centuries, but the catastrophe that confronted the young monk was unprecedented. A mysterious disease had wiped out almost every apiary on the Isle of Wight and now was devastating the rest of England. Brother

Adam found his hives suddenly vacant, bees crawling beneath them, unable to fly. That year he lost 29 of the abbey's 45 hives.

Scientists eventually linked the disease to a previously unknown virus. But the research came too late to save Britain's native dark brown honeybee. Almost all the surviving hives were hybrids, the progeny of local drones that mated with foreign-bred queens. The apparently superior vigor of these blends made Brother Adam think about breeding a disease-resistant bee.

In 1950, after years of preparation, he finally got his chance. Commandeering an old abbey car, he traveled over the next 37 years through Europe, the Middle East, and Africa, collecting more than 1,500 queens: the hardworking bees of northern Turkey, the hyper-diverse bees of Crete, the isolated bees of Sahara oases, the deep black bees of Morocco, the tiny orange bees of the Nile, the supposedly placid bees of Mount Kilimanjaro. He took his exotic menagerie to a remote station in the moors, miles from other bees with their unwanted genes. Performing countless breeding tests in pristine solitude, he created the Buckfast bee—a superbee, as it was quickly dubbed. Tan-colored and robust, it was reluctant to sting, zealously productive, and resistant to what had come to be called Isle

of Wight disease. By the 1980s Buckfast bees were sold across the world. Bee breeders are rare. Brother Adam had become something even rarer: an apiculture celebrity.

But honeybees were again under assault. An Asian mite with the evocative name of *Varroa destructor* had invaded Europe and America. "Only a fully resistant, genetically endowed race or strain," Brother Adam proclaimed in 1991, will be "the ultimate answer to this menace." But before he could begin work, Buckfast's abbot, convinced that Brother Adam's growing fame conflicted with his vocation, removed him from his post. He died, heartbroken, in 1996. "Nobody really took his place at the abbey," says Clare Densley, who two years ago restarted Buckfast's storied beekeeping operation.

All the while, conditions worsened in Beelandia. In 2007 reports of "colony collapse disorder"—swift, terrible deaths of entire colonies—suddenly mushroomed across Europe and the Americas. News reports called it a "threat to global agriculture" and an "unprecedented catastrophe for the planet." The headlines were justified: Insect pollination, mostly from honeybees, is critical to one-third of the world's food supply.

Bee researchers, many inspired by Brother Adam, rushed to understand colony collapse. Most have concluded it is not a single problem, as first thought, but a lethal amalgamation of pests, pathogens, habitat loss, and toxic chemicals; varroa mites are a critical component. Most large-scale beekeepers now use pesticides to kill

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*Charles C. Mann's latest book is 1493: Uncovering the New World Columbus Created. Anand Varma, a biologist who raised bees for this story, specializes in photographs that illuminate science.*



By Charles C. Mann  
Photographs by Anand Varma



In 2007 headlines shouted about “colony collapse disorder,” a frightening new phenomenon that was wiping out hives around the world. Most researchers now believe that it is actually a deadly mix of pests, pathogens, pesticides, and habitat loss. The single worst element is *Varroa destructor*, a pinhead-size Asian mite, shown here atop a bee pupa.

the mites—a stopgap solution, at best. To avoid chemicals, some bee researchers are returning to Brother Adam’s approach: Superbee Version 2.0. Only this time, they are using the tools of big science, including genetic modification. Others tout the opposite approach, one even more natural than Brother Adam’s. No chemicals, no manipulation—let the bees evolve on their own!

“Unfortunately, none of these approaches has yet produced a sufficiently mite-resistant and

productive bee. And by ‘sufficiently’ I mean a bee that’s a game changer,” Keith Delaplane, director of the University of Georgia’s honeybee program, told me. Meanwhile, he says the pressures on the bee are enormous. “I stand in front of beekeepers and say, ‘You all tell me the success stories.’ I do not see any hands going up.”

HONEYBEES ARE SUPERORGANISMS. Honeybees are hive minds. Honeybees are linguistic networks:



In a USDA lab, technician Sharon O'Brien holds the stinger of a sedated queen bee with forceps as she prepares to inject semen into the insect's oviduct (the passage to the ovaries). The researchers are trying to breed honeybees that naturally resist *Nosema ceranae*, a fungal parasite from Asia that is hitting honeybee colonies in Europe and the United States.

SOURCE: USDA AGRICULTURAL RESEARCH SERVICE LAB FOR HONEY BEE BREEDING, GENETICS, AND PHYSIOLOGY RESEARCH, BATON ROUGE





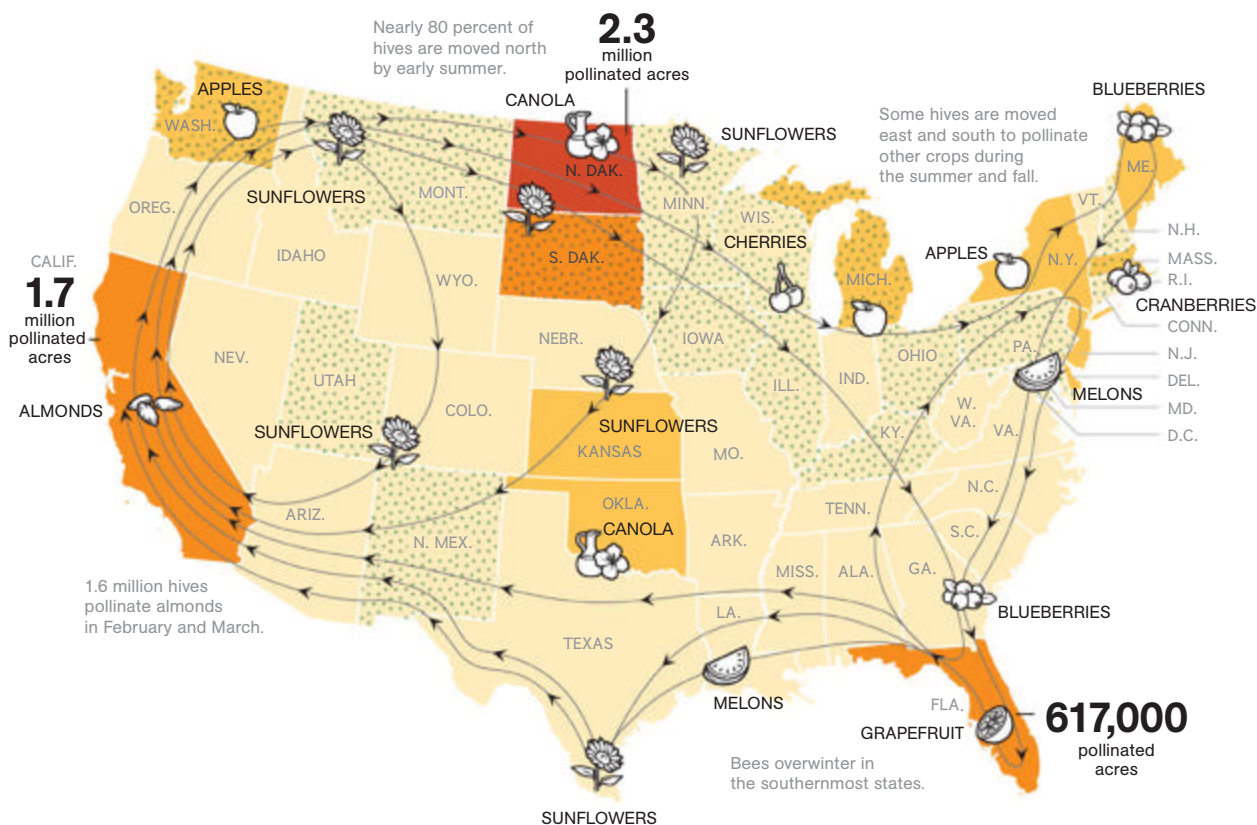
Encircled by nurse bees, a queen in an experimental mite-resistant colony extends her tongue to be fed. The queen, bred by USDA researchers, is “hygienic”—she produces workers that instinctively detect and kill mite-infested pupae. Scientists are now developing hygienic bees that also have traits valued by beekeepers: docility, hardiness, and prolific honey production.

SOURCE: USDA AGRICULTURAL RESEARCH SERVICE LAB





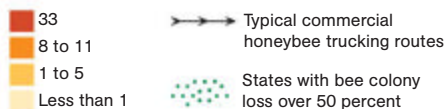




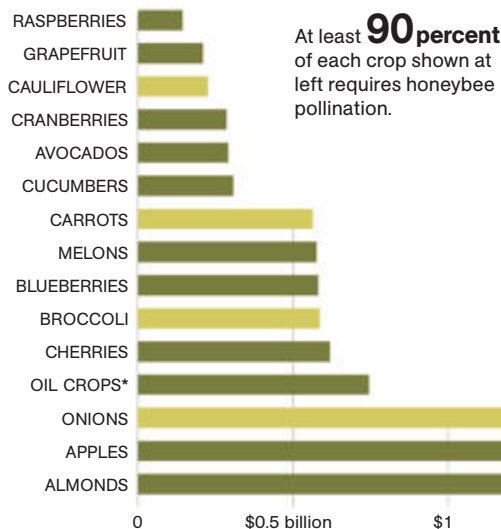
## Bees on the Move

Commercial beekeepers transport the insects thousands of miles around the country every year to pollinate crops when they're in bloom. According to the Department of Agriculture, one-third of the foods in the U.S. diet rely on bees and other pollinators.

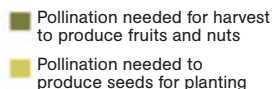
### Acres of pollinated crops per square mile by state



One square mile equals 640 acres.



### Market value of crops pollinated by honeybees



The **\$2.8 billion** almond industry could not exist without honeybee pollination.

Values are in 2010 U.S. dollars. Data exclude Alaska and Hawaii.

\*Oil crops include canola, sunflower, and rapeseed oil.



One of the few nonhuman animals to communicate symbolically, they dance to explain the location of food to their fellows. Bee people use such metaphors but admit they don't quite capture these complex, fascinating creatures and their ultra-organized communities. With a population of up to 80,000, a beehive is like a small human city.

Bumblng and buzzing, these industrious animals—*Apis mellifera*, as scientists call them—search flowers for tiny drops of a sugary secretion called nectar. Bees slurp the nectar into their “honey stomachs,” which break down the sugars. Inside the hive they regurgitate the goop and fan it with their wings to evaporate the water. The sweet, gluey result—honey—is stored for winter food or stolen by humans. A pound of clover honey, ecologist Bernd Heinrich has estimated, “represents the food rewards from approximately 8.7 million flowers.”

When you watch bees single-mindedly labor to make honey, it's hard to believe that their greatest role in nature is something they are entirely unaware of: distributing pollen. Pollen is, in effect, the male part of a plant; it transfers DNA to the female part of the flower, an essential step in reproduction. Plants can disperse pollen by wind or animals, usually insects. As *Apis mellifera* hunts for nectar in flowers, pollen grains stick to its hairy body. When it visits more flowers, some of the pollen drops off, fertilizing the plant. Plants that rely on wind emit vast clouds of pollen, hoping a few grains will drift into other flowers. From an evolutionary point of view, harnessing insects is so much more efficient that insect-pollinated plants typically make one-thousandth as much pollen as their wind-dependent cousins.

Not until I visit Adam Novitt do I understand how all this works. Novitt, a beekeeper in Northampton, Massachusetts, keeps hives in his small urban backyard. His is an artisanal, locavore operation—“I'm at constant risk of sounding like an extra in *Portlandia*,” he says, referring to the hipster-skewering television series. Each jar of his Northampton Honey is labeled with the zip code where his bees labored. Novitt endured a two-year wait to obtain his much-in-

demand Buckfast queens. Demonstrating their gentleness, he removes the tops from his hives without gloves or veil. A barnyardy smell—wax and honey and wood—rises into the air. On the combs the bees tumble over each other like children at a day care center.

Some of Novitt's bees are stippled with reddish, pinhead-size dots: *Varroa destructor*. The mites latch on like ticks or leeches, draining bloodlike hemolymph from their hosts and enfeebling their immune systems. The hive environment—steamy and warm, bees in constant contact—is as perfect for bee pathogens as a day care center is for human pathogens. “The mite opens up the road; the bacteria or fungus or virus does the rest,” Novitt says. He snaps his fingers. “*Pfft!*—colony collapse.” Before varroa, he tells me, beekeeping was mostly a matter of bee-having—“they needed minimal attention, most of the time.” Since the mite arrived, “you really have to keep them.” Beekeeping, he says, should actually be called “mite management.”

Most farmers facing insect issues turn to chemicals, such as the pesticides sprayed on apple trees to control maggots. Even though mites and bees are more closely related than apples and maggots, chemical firms have discovered a dozen or more effective miticides. The chemicals are widely used, but not a single bee researcher, commercial beekeeper, or bee hobbyist I spoke with was happy about putting toxins into hives. In addition, scientists report, many varroa are already resistant to commercial miticides.

A different, potentially nontoxic treatment is envisioned by Beeologics, an arm of the agribusiness giant Monsanto, which uses RNAi (the last letter stands for “interference”). RNA molecules in cells carry the information from genes—that is, particular segments of DNA molecules—to the cellular machinery that makes proteins, the chemical building blocks of life. Each protein has a unique makeup, as do its associated RNA and gene. In RNA interference, cells are targeted with a substance designed to attack a specific variant of RNA. Crippling that RNA snaps the link between a gene and its protein. In the Beeologics version, bees would be fed sugar water containing

RNAi, which disables mite RNA. In theory the doctored sugar water should not affect the bee. But when mites drink the bees' hemolymph, the mites will also take in RNAi—and it should affect them. It's as if you could kill vampires by eating pizza with garlic sauce.

Jerry Hayes of Monsanto Honey Bee Health hopes to have something on the market within five to seven years. The biggest challenge, he says, is creating a stable product—something beekeepers “can ride around with in a truck in Montana when it's a hundred degrees out.”

Problem is, Marla Spivak says, RNAi is still a single-purpose tool. Spivak, of the University of Minnesota, is the only bee researcher ever to receive a “genius” grant from the MacArthur Foundation. “If you target one specific area,” she argues, “the organism will always make an end run around it.” Staving off the beepocalypse, in

interrupting the mite's reproductive cycle.

Spivak and Harbo both succeeded in breeding versions of hygienic bees by the late 1990s. A few years after that, scientists realized that hygienic bees are less effective as the mites grow more numerous. How to overcome that remains uncertain, in part because the genetic basis of hygienic behavior is not yet understood. Similar problems beset another breeding target: grooming. By running their middle legs over their bodies, honeybees tidy themselves and each other. If bees groom before mites attach themselves, they can dislodge the pests. An obvious goal is a hygienic bee that grooms intensively. But breeders fear they will produce bees that primp constantly, like vain adolescents. And always there is the worry that breeding for one trait will compromise others—that hygienic bees, for instance, will be aggressive or make little honey.

**B**lindly breeding two bees that have a desired trait is like banging together two handfuls of marbles and scooping up the result.

her view, ultimately requires a “healthier, stronger” honeybee, one that can fight mites and disease on its own, without human assistance.

In parallel efforts, two groups of researchers—Spivak and her collaborators, and John Harbo and his colleagues at the U.S. Department of Agriculture's research center in Baton Rouge, Louisiana—sought to breed mite-resistant bees. Although their approaches were different, they took aim at the same target: “hygienic” bees.

All *Apis mellifera* larvae grow in special cells in the comb, which adult bees fill with food and cap with wax. Mites enter the cells just before they are sealed and lay their eggs. When they hatch, the young mites feed on the helpless, immobile bee pupae. When the fully grown bee emerges into the hive, mites dot its back or belly. Unlike most honeybees, hygienic bees can detect mites inside sealed cells, probably by smell, then open the caps and remove infested bee pupae,

Ultimately, solving these quandaries will require molecular biology, argues Martin Beye, a geneticist at Heinrich Heine University in Düsseldorf, Germany. To a geneticist, blindly breeding two bees that have a desired trait is like banging together two handfuls of marbles and scooping up the result. It's much more effective to identify specific genes responsible for the desired traits and insert them. A consortium of more than a hundred researchers decoded the honeybee genome in 2006. Beye was part of the group. The next step, in his view, would be to identify genes that influence certain behaviors—and, if needed, modify them.

Although scientists had produced transgenic insects since the early 1980s, all attempts to insert genes into *Apis mellifera* had failed. Beye assigned the task of discovering a method to a young researcher, Christina Vleurinck. Science is like moviemaking: The result can be exciting,



but the process is excruciating. Vleurinck had to extract eggs from a colony, inject genetic material (in this case a gene that makes certain tissues glow under fluorescent light), and reinsert the eggs into the hive. Time after time the new genes didn't take. Poking needles into the eggs often resulted in damaged embryos. Worker bees swiftly killed them. It was like having thousands of tiny critics, each with the ability to close the show. With Beye and two other collaborators, Vleurinck gradually developed a successful technique. Still, it will take years of work before the method can be used to develop a better bee. And releasing genetically modified bees is bound to be controversial. "This is new ground," Beye says. "People will want to be careful."

Vleurinck's bees are kept in a tent, sealed off from the outside world, as required by German laws about transgenic organisms. During my visit a staffer takes me into the tent, extracts a comb from a Styrofoam bee box, and lets me inspect it. It is covered with genetically modified bees. To my untrained eye, they look exactly like ordinary bees, except unhappier. When not allowed to fly freely, bees get grouchy. In the course of her research, Vleurinck was stung so many times she became allergic to bee venom. "I'm not allowed inside with them," she says.

ALL OF THIS makes Phil Chandler, the author of *The Barefoot Beekeeper*, roll his eyes. A preacher in the Church of Everything You Know Is Wrong, he argues that too many scientists, even if well-meaning, are effectively part of the problem. "We cannot solve our difficulties by using the type of thinking that created them," Chandler says. He's referring to the "persistent delusion" that humans can control nature. Better bees can be built, he believes, but only by bees themselves. The biggest enemy of honeybees, he contends, is not mites or viruses but industrial agriculture. Many scientists ruefully agree. The disagreement comes over what to do about it.

A century ago many crops were still pollinated by feral bees. Then family farms turned into agribusiness operations. Bees need to forage for food much of the year, but fields devoted to

single crops typically have flowers for just a few weeks, while weeds that could tide bees over are killed by herbicides. So few bees now exist that farmers must rent hives from huge commercial outfits that transport them from crop to crop in 18-wheelers. The peak or nadir occurs every February and March, when about 1.6 million hives from all over converge on California's Central Valley to pollinate almonds. In a few frenzied weeks, the hordes help produce about 80 percent of the world's almond supply.

I meet Chandler near Buckfast Abbey, at a gathering of beekeepers. Many around him agree with his diagnosis. Still, they look vexed when he says that the best thing to do for varroa would be...nothing. Keep bees healthy and well fed, but let evolution work. For ten years or more, beekeepers might lose most of their bees, he concedes. But natural selection would eventually lead to some kind of resistant bee. "We have to think of these issues in terms of what is best for bees," he says. "Not what is best for us."

Chandler is not optimistic about the future for *Apis mellifera*; Densley, the Buckfast Abbey beekeeper, is worried, but more hopeful. To cheer them up, I tell them about Harvard University's RoboBee project: an effort to create tiny, pollinating drones. In principle, the technology is feasible. Autonomous robots identify flowers by color, hover above them, and insert soft probes that pick up pollen. It might take the pressure off real bees, I suggest.

Chandler doesn't look reassured. Densley too seems less than enthusiastic. "I'm not ready for a world of mechanical bees," she says. "I think I like the ones we have." She, like other bee people, is waiting for something to happen. □

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VIDEO

### ***It's Alive! See Bees Transform***

From tiny hatching eggs to quivering pupae to hair-sprouting adults, worker honeybees develop at lightning speed thanks to a time-lapse video of 2,500 images.







A bee extends its proboscis to drink sugar water from a cotton applicator at a Pennsylvania State University lab. To measure the effects of agricultural chemicals, researchers are comparing the rate at which two groups of bees—one group that has been exposed to farm sprays and one that has not—learn that puffs of scented air will be followed by rewards. Increasingly, scientists believe that many compounds thought to be safe for bees subtly harm them.

SOURCE: MULLIN LAB, DEPARTMENT OF ENTOMOLOGY, PENN STATE





On a secluded California ranch, Bret Adee opens one of his 72,000 hives. South Dakota-based Adee Honey Farms, the nation's biggest commercial beekeeper, trucks bees all over the West to pollinate fruit trees—a practice both critical to agriculture and stressful for bees. Since 2011, Adee has worked with the USDA to test the hardiness and honey production of its mite-resistant bees in the field.







# *Harnessing the Mekong or Killing It?*

Dams are rising all along the Mekong. The people of Southeast Asia need the clean electricity—but also the fish and rice that an undammed river provides.





## ***Laos***

A fisherman prepares to cast his nets at a section of Khone Falls, the largest waterfall by volume in Asia. Some of the flow will be diverted to make electricity at the Don Sahong dam, soon to rise on a side channel.







## China

In 2012, when this photo was taken, construction of the Miaowei dam was well under way. When finished next year, it will be the eighth dam on the Lancang River—China's name for its 1,300-mile stretch of the Mekong.

PANORAMA COMPOSED OF TWO IMAGES









## *Thailand*

The hunger for electricity in Thailand is driving dam construction on the lower Mekong in Laos and Cambodia. Bangkok's CentralWorld complex (at right) houses some 500 shops, a hotel, and an ice-skating rink.



By Michelle Nijhuis  
Photographs by David Guttenfelder

**P**umee Boontom lives in northern Thailand, but he tunes his television to the Chinese weather forecast. A big storm in southern China means a big release of water from the

Chinese dams upstream—and, in turn, a good chance his village will be flooded. The Chinese government is supposed to warn downstream countries. In Boontom's experience, that warning tends to arrive too late or not at all.

"Before the dams, the water would go up and down gradually, with the seasons," he says. "Now the water goes up and down drastically, and we don't know when it's going to change—unless we watch the storms."

Boontom is the leader of Ban Pak Ing, a scattering of cinder block houses and unpaved streets that reach from the precipitous west bank of the Mekong toward a quiet, well-cared-for Buddhist temple. Twenty years ago, like many of his neighbors, Boontom caught fish for a living. But as China completed one, then two, and then seven dams upstream, the few hundred residents of Ban Pak Ing saw the Mekong change. The sudden fluctuations in water levels interfere with fish migration and spawning. Though the village has protected local spawning grounds, there are no longer enough fish to go around.

In recent years Boontom and many others here have sold their fishing boats and switched to farming corn, tobacco, and beans. It's a chancy living, and not the one they know best—and it's made even more challenging by the frequent flooding. In 2008 some homes were flooded to the second floor. The temple was inundated too.

Ban Pak Ing may be a vision of the future for many Mekong villages. Five more dams are under construction in China. Downstream, in Laos and Cambodia, 11 major dams—the first on

the main stem of the lower Mekong—are either proposed or already being built. By disrupting fish migration and spawning, the new dams are expected to threaten the food supply of an estimated 60 million people—most of whom live in villages much like Ban Pak Ing. The electric power generated by the lower Mekong dams is destined largely for booming urban centers in Thailand and Vietnam. Kraisak Choonhavan, a Thai activist and former senator, calls the lower Mekong dams "a disaster of epic proportions."

One of the proposed dams in Laos is just 40 miles downstream from Ban Pak Ing. Its construction would squeeze the village between flooding from the north and a rising reservoir in the south. Boontom, now in his 50s, says he's worried not for himself but for the next generation. "Just close your eyes and imagine," he says. "Imagine what will happen to us." He slams his hands together.

THE MEKONG BEGINS ON the Tibetan Plateau and runs for more than 2,600 miles through China, Myanmar, Thailand, Laos, Cambodia, and Vietnam before emptying into the South China Sea. It's the longest river in Southeast Asia, the seventh longest in Asia, and—most important for the people who live along it—the world's most productive inland fishery. Cambodians and Lao-tians catch more freshwater fish per capita than anyone else on the planet; in many places along the river, fish is a synonym for food. Grilled, fried, or boiled; wrapped in palm leaves; garnished with ant eggs; or simply mixed with rice





**Thailand** Nighttime is floodlit fun time for this group striking a pose beneath the Ferris wheel at Asiatique, a new shopping center in Bangkok. The Mekong is hundreds of miles away.

in a wooden bowl, the more than 500 known species of Mekong fish have sustained millions of people through droughts, deluges, and even the genocidal Cambodian regime of Pol Pot.

Yet the Mekong's narrow gorges and roaring waterfalls, which frustrated 19th-century European explorers in search of a trade route from the South China Sea to western China, have long tempted dambuilders. In the 1960s the United States advocated the construction of a series of hydropower dams on the lower Mekong, hoping to develop the region's economy and head off the rise of communism in Vietnam. The plans languished, the region descended into war, and in the 1990s China, not Southeast Asia, became the first to dam the main stem of the river.

Today Southeast Asia is relatively peaceful, and for the most part, its economies are humming. But only about a third of Cambodians and just over two-thirds of Laotians have access to electricity, and that power is often painfully expensive. Economic and population growth will further strain electricity supplies:

A 2013 analysis by the International Energy Agency predicts that the region's demand for power will increase by 80 percent in the next 20 years. Clearly the region needs more energy—and if the worst effects of global warming are to be avoided, the world needs that energy to produce as little carbon as possible. The hydropower potential of the Mekong is more tempting than ever.

Dam construction on the lower Mekong is overseen, nominally, by the Mekong River Commission (MRC). Funded by international development agencies and by its four member nations—Vietnam, Cambodia, Thailand, and Laos—the commission is held together not by a legally binding treaty but by a shared interest in the river and in regional peace.

China is not a full member of the commission; it has no explicit obligation to consult with

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*Michelle Nijhuis wrote about California's drought in last October's issue. Photographer David Guttenfelder's photos of North Korea appeared in October 2013.*



From its headwaters on the Tibetan Plateau, the Mekong River flows more than 2,600 miles through six countries before emptying into the South China Sea at its delta in Vietnam.



The communist government in Laos hopes that energy from its proposed dams will make Laos "the battery of Southeast Asia."

The Mekong flows through Myanmar for just 120 miles.

**Mekong River dams**

- Existing
- Under construction
- Planned

RYAN MORRIS, NGM STAFF  
SOURCES: WORLD FISH CENTER; INTERNATIONAL RIVERS;  
MEKONG RIVER COMMISSION; KUNMING INSTITUTE OF  
BOTANY, CHINESE ACADEMY OF SCIENCES  
NOTE: CHINA'S BAITA DAM (PLANNED) NOT SHOWN ON MAP.



China has more than 23,000 large dams, more than any other country—and two-fifths of the world's total. It's also a leading builder and financier of dams abroad, including along the lower Mekong.

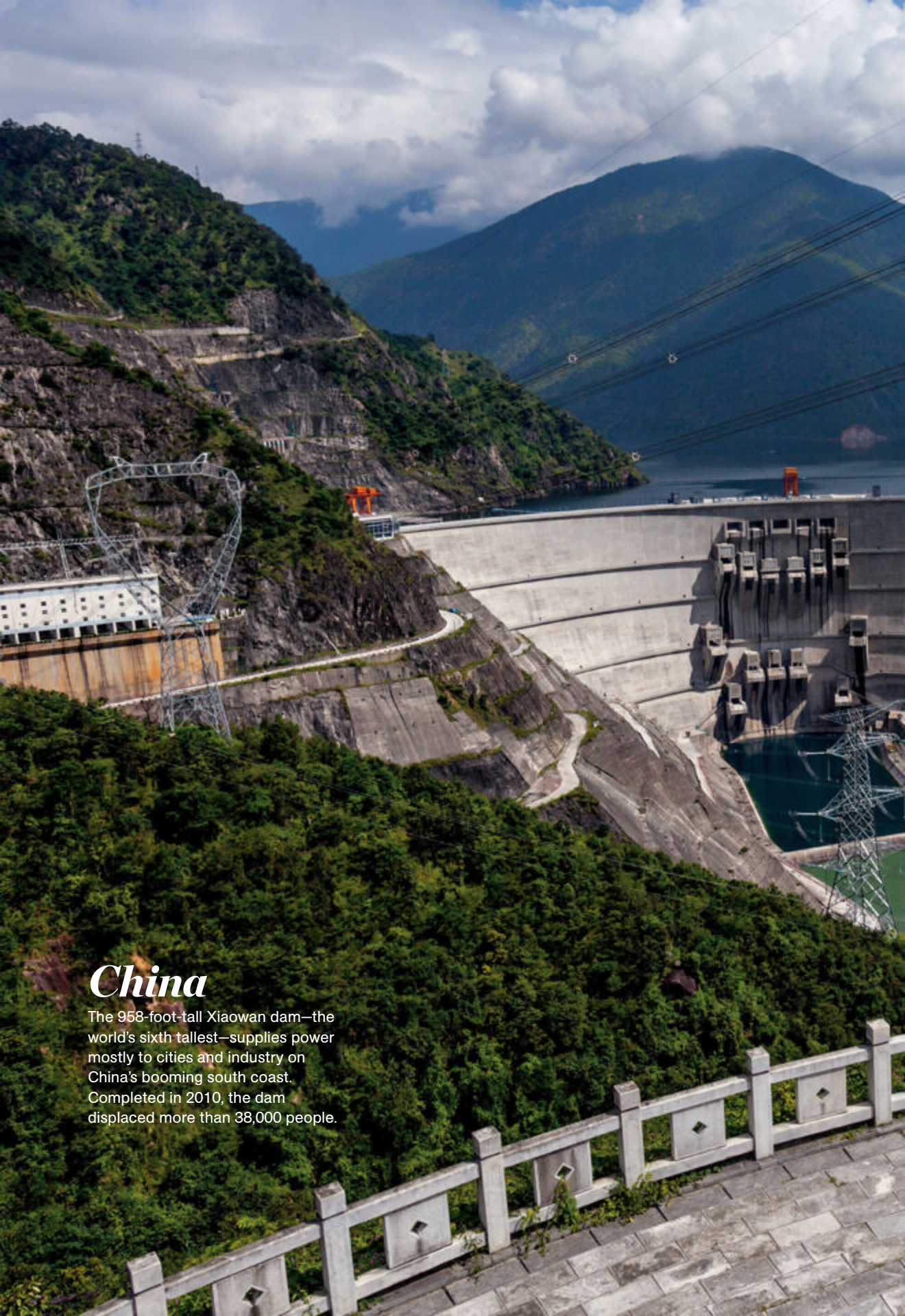
## Threatened Lifeline

Some 60 million people rely on fish caught in the Mekong River and on rice grown in its fertile delta. But the river is changing. China has built seven major dams in the past two decades; it has 21 more under construction or planned. This so-called Mekong cascade is now headed downstream, with 11 new dams expected along the main stem in Laos and Cambodia. Those plans are pitting the region's need for electricity against its need for food and against the livelihoods of fishermen and farmers, who depend on the river's free-flowing waters.

1. The tallest dam of the cascade, China's **Xiaowan dam** began operating in 2010.
2. **Nuozhadu dam** began producing hydroelectric power in 2012.
3. Laos is building the **Xayaburi dam** despite objections from Cambodia and Vietnam, which fear its impact on food security and the Mekong's ecology.
4. Construction will soon begin on the **Don Sahong dam**, blocking the only route that's passable year-round by fish migrating between Cambodia and Laos.
5. The **Lower Sesan 2 dam**, on a tributary near the river's confluence with the Mekong, will also block a key fish migration route.
6. The **Sambor dam** could generate up to 2,600 megawatts as currently planned, but it would displace some 19,000 people.

SCALE VARIES IN THIS PERSPECTIVE. LENGTH OF MEKONG RIVER BASIN IS APPROXIMATELY 1,800 MILES (2,900 KILOMETERS); ITS AREA IS APPROXIMATELY 307,000 SQUARE MILES (795,000 SQUARE KILOMETERS).





## *China*

The 958-foot-tall Xiaowan dam—the world's sixth tallest—supplies power mostly to cities and industry on China's booming south coast. Completed in 2010, the dam displaced more than 38,000 people.









**China** New dams and their reservoirs have flooded riverside towns, farms, and roads. Along a reservoir created by the Gongguoqiao dam, goats are herded to pasture on a new elevated highway (above). Near the Wunonglong dam (below), workers build new houses high above the river for families who lost their homes.





its downstream neighbors about its activities on the upper Mekong. The consequences of this arrangement became all too clear in 1995, when member countries planned to celebrate the signing of a major agreement with a ceremonial boat trip on the Mekong: The river was filling the reservoir behind a newly constructed Chinese dam, and the water downstream was too shallow for boats. The trip had to be scrapped.

More recently the 11 main-stem dams proposed in Laos and Cambodia have undercut the fragile power of the commission. In 2010 an environmental assessment sponsored by the MRC called for a ten-year moratorium on construction of main-stem dams, citing their potentially devastating effects on regional food supplies and the likelihood of “irreversible environmental damage.” But Laos, a poor and long-isolated country that is now courting foreign investment, aims to become the “battery of Southeast Asia” by selling hydroelectricity to Thailand and other neighbors—and it was not deterred by opposition from the MRC or even from Vietnam, its traditional ally. In late 2012, after years of denials, Laotian officials admitted that construction of the Thai-financed Xayaburi dam, on a remote stretch of the Mekong in northern Laos, was under way.

The Xayaburi dam will be more than a hundred feet high and a half mile long when it’s completed, perhaps as soon as this year. When I visited the site in 2013, the riverbanks upstream were already punctuated with mines supplying sand and gravel for dam and road construction. At the site itself, cranes dangled over the river, and knots of workers in hard hats were using explosives to carve the steep banks into smooth terraces, ready to be filled with cement.

In a small village directly across the river, residents said they’d been enduring regular blasting for the past three years. They were preparing to move to a newly constructed village upstream, and some sounded optimistic. They were looking forward to new houses and to escaping the lengthening shadow of the dam. Many hoped to continue fishing.

Until 2012 another village lay immediately downstream of the dam site. In 2013 its residents were settling into a grid of new cinder-block-and-wood houses well out of the river canyon. There, optimism was scarce. Residents said the money and land promised by the dam company as compensation for relocating were inadequate

and slow in coming. Many were feeling the unfamiliar bite of the cash economy. “In the old village you didn’t make much money, but you could eat the rice you grew,” said a young woman with two children. “Here you can make money every day, but every day you have to spend more than you make.”

EVEN AS THE XAYABURI DAM upsets the lives of the people around it, its biggest impact may lie in the example it has set. By defying the recommendations of the MRC-sponsored assessment and building the Xayaburi, Laos has paved the way for the rest of the proposed cascade of dams—some of which pose much more fearsome threats to the Mekong.

### ***China has no explicit obligation to consult with its downstream neighbors about its activities on the upper Mekong.***

The heart of the Mekong fishery is in Cambodia, where a large lake called the Tonle Sap is bound to the main stem of the Mekong like a lung to a windpipe. The Tonle Sap expands during the wet season and shrinks during the dry, and at its peak is so large that from the center it seems as vast as the ocean.

The muddy water and shifting currents of the Tonle Sap form a natural fish factory, nurturing finger-length silverfish, 650-pound catfish, and hundreds of species in between. The bounty supports a small nation of “floating villages,” clusters of houseboats anchored along the lake’s edge. Despite pollution and heavy fishing pressure, fish are still so numerous in the Tonle Sap that in the winter, when the water is low, fishermen and women can scoop up their catches in large bamboo baskets.

More than a hundred species of fish that hatch in the Tonle Sap migrate long distances upstream, some as far north as Laos. The Xayaburi dam, approximately 550 miles upriver, may be too distant to have much of a direct effect on them, but other projects are much closer. Just north of Cambodia’s border with Laos, another



## ***Laos***

In Ban Khok Yai, along the Mekong River, three generations share dinner by candlelight—like 30 percent of Laotians, they lack electricity. Their village will be inundated when the nearby Xayaburi dam is completed.









**Laos** Near where the Don Sahong dam will soon rise, a fisherman's son snoozes above his father's weir (above), waiting for fish migrating upstream to tire and wash back into the trap. Hundreds of miles to the north (below), a boat adorned with artificial flowers heads toward the Xayaburi dam construction site.





main-stem dam called the Don Sahong will soon be under construction. Though it will close off only one channel of the braided river, it will certainly interfere with fish migration, and it will further threaten the habitat of Irrawaddy dolphins, of which fewer than one hundred remain in the Mekong.

An even greater danger to the fishery looms in northern Cambodia itself, on a tributary of the Mekong called the Tonle San, or Sesan River. The Sesan originates in Vietnam and meets the Mekong about 30 miles downstream from the Don Sahong. It's known to be a key migration route for dozens of fish species, including many that local people depend on. A dam called the Lower Sesan 2, which would sever the Sesan's connection with the Mekong, is now being built 16 miles east of the confluence.

The village of Vern Houy lies just upstream from that dam site. It's accessible only by boat, and most of its residents grew up there. Many speak Lao as a first language. When I asked a group of women what the dam will mean to them, they said: "We're going to die." I asked my translator, a young reporter from the national capital of Phnom Penh, if their words were meant literally. "It's a real fear," he said. "They really think they're going to die." This is the only life they know; they cannot imagine another. The reservoir will flood the village so frequently as to make it all but uninhabitable.

In the house of the village leader, a single room built on stilts and enclosed with grass mats, a group of men gathered for a meal of freshly killed duck and hot sauce. The deputy chief of the village, In Pong, said that with the help of a regional advocacy group, the 3S Rivers Protection Network, residents of Vern Houy had joined with nearby villages to protest the dam, writing letters to the Cambodian Parliament and traveling to the capital to press their case—fruitlessly, so far. "I wouldn't move anywhere, especially not to the city," Pong said. "I have no idea what to do."

Loek Soleang, a local teacher and one of the few residents not born in the village, countered Pong. "I'm not worried," he said. "We can use the electricity. We need development. If they flood here, we'll just move to higher land."

The men around him did not argue; they stared quietly at their laps. Pong pulled on his cigarette and puffed the smoke contemplatively out the open window.

LOEK SOLEANG WAS RIGHT about one thing: People in the Mekong Basin need more electricity. Vern Houy has none at all. In the village of O Svay, downstream from the Don Sahong dam site, there are dirty, noisy diesel generators. Only the most prosperous families can afford them. In O Svay, as in much of rural Southeast Asia, only the most fortunate kids can finish their homework by lamplight or use a small fan to help them sleep in the sweltering summer heat. Life without reliable power isn't easy or romantic.

Both Cambodian and Laotian officials say that dams can benefit their countries' poor people by making electricity cheaper and more available. While Cambodia opposes the main-stem

***People along the Mekong need electricity. There are diesel generators—but only the most prosperous families can afford them.***

dams upstream in Laos, officials praise the Lower Sesan 2 and other tributary dam projects. "The livelihoods possible with energy are better than those possible with the fishery," says Touch Seang Tana, chairman of a Cambodian commission for Mekong dolphin conservation and economic development. "Dams are a way for people to move beyond subsistence."

The dams planned for Cambodia and Laos would produce power far in excess of the countries' domestic demand, but they would not make electricity universally available in those two countries. Ninety percent of the power the main-stem dams produce would be sold to Thailand and Vietnam, and most of the cash they brought in would go to the companies that built them, not the poor people who live along the river. The 2010 analysis commissioned by the MRC predicted that the fishery losses caused by the projects would actually worsen poverty.

Some officials argue that aquaculture and rice cultivation can make up for any decline in the food supply, but fisheries experts vehemently disagree. The effects of the main-stem dams on the Mekong fishery, they say, would be



## *Cambodia*

Fish pour out of the nutrient-rich Tonle Sap lake during the dry season, when its floodwaters recede into the Mekong. Dams may disrupt the seasonal flood cycle that underpins the fishery, which supplies many Cambodians with protein.









***Cambodia*** Two children scramble home on the edge of the Tonle Sap (above), where houses are on stilts to weather the lake's seasonal fluctuations. Near its center, a merchant with a generator (below) charges car batteries that residents of his floating village use to power lights. Most Cambodians lack electricity.





cumulative, inexorable, and devastating. On other rivers in the region, fish catches dropped between 30 and 90 percent after dams were built. And though aquaculture is already widely practiced along the Mekong—in many houseboats a trapdoor leads to a watery pen of farmed fish—those fish are fed with smaller wild fish from the river. Replacing those feed fish with factory food would be prohibitively expensive for most producers. Like the Laotian villagers forced to move by the Xayaburi dam, many who depend on fishing and small-scale aquaculture are likely to be shoved into the cash economy without the capital or knowledge they need to survive in it.

The Mekong is not the region's sole source of low-carbon power. The 11 dams proposed for the main stem of the lower Mekong are projected to meet roughly 6 to 8 percent of Southeast Asia's electricity demands by 2025, and analyses show that efficiency measures and investments in solar and other cleaner-energy technologies such as cogeneration—the use of waste heat from power plants—could yield as much or more power at less cost. But in Southeast Asia, such alternatives are in their infancy. To the Cambodian and Laotian governments, hydropower is both more familiar and accessible, and more valuable as an export commodity.

Is it possible to harness the Mekong's power while protecting its abundance? A 2012 study by Princeton ecologist Guy Ziv and his colleagues analyzed 27 dams proposed for the river's tributaries, comparing the projected power from each with its likely damage to fisheries. They found vast differences in the ecological costs of the projects. The Lower Sesan 2 was by far the worst; it alone would reduce fish biomass in the lower basin by more than 9 percent. Conversely, a few dams carefully placed elsewhere in the watershed could produce significant power with minimal damage to food supplies.

Such planning, however, would require the Mekong nations and their investors to coordinate with one another, and coordination is exactly what's lacking in the haphazard, secretive push to dam the Mekong Basin. "To really do water development well, you have to work at the basin scale," says Brian Richter, a water expert with the Nature Conservancy. "You have to in some sense look at the Mekong as a game board, one where you can decide to put a dam here and not there and by doing so maintain

the ecological functioning of the whole river basin. That's been extremely difficult to do on the Mekong."

MORE THAN A THOUSAND MILES downstream from the Chinese dams, the Mekong Delta's seemingly endless network of marshes, canals, and polders—tracts of reclaimed land—stretches to the South China Sea. The delta has long been a literal and metaphorical quagmire, especially for the Vietnamese, French, and American forces who spent decades fighting and dying there.

Near its center, in the market town of Can Tho, wetlands ecologist Nguyen Huu Thien stands on the waterfront and gestures at the phalanxes of passing motorcycles, most ridden by young

***The effects of the dams on the Mekong fishery, experts say, would be cumulative, inexorable, and devastating.***

Vietnamese. "How many of them know about the dams?" he asks. "Very, very few of them have any idea what's going to happen."

Nguyen grew up in the delta in the 1970s, and like many other kids, he routinely swam in the canals and flooded fields, catching fish with his hands. Unlike his older siblings, whose schooling was constantly interrupted by war, Nguyen was able to attend college and, eventually, to study conservation biology at the University of Wisconsin. Today he speaks colloquial English and professes a soft spot for Mark Twain and the education Twain got on the Mississippi River. "I learned theory in Wisconsin, but the Mekong Delta is unique," Nguyen says. "I had to learn about it here, in the middle of it."

The mix of salt water and freshwater in the delta, and the centuries of human efforts to direct it, have resulted in a complex engineered landscape, one that is too often treated as separate from the rest of the Mekong. In 2009 Nguyen was working on wetlands restoration when he was asked to contribute to the MRC's assessment of the proposed main-stem dams in Laos and Cambodia. He soon realized the dams







## *Vietnam*

Unbalanced by abundance, a tractor in the Mekong Delta threatens to dump its load of rice. The warm, humid delta, fertilized by river sediment, has allowed Vietnam to become a major rice exporter.





**Vietnam** Merchants at one of the Mekong Delta's many floating markets (above) sell the fruits of the delta's fertile soils, including watermelons. A riverboat loaded with rice (below) moves slowly through one of the canals that crisscross the delta. Dams will trap fertile sediments upstream, threatening harvests.





would doom all his earnest efforts in the delta.

Its balance of river and sea is already shifting. Recent droughts have weakened the river and allowed seawater to intrude farther upstream, causing serious problems for farmers. The upstream dams would convert more than half the lower Mekong into reservoirs, completely altering its flow. They'd trap much of the nutrient-rich sediment that now fertilizes delta fields and feeds fish throughout the Mekong system—which extends beyond the river itself. The boats that fish its enormously productive plume in the South China Sea can catch more than half a million tons a year.

In the delta Nguyen sees the limits of human ingenuity: Though its canals and polders have boosted rice production, they're ultimately no match for the sea. Likewise, he says, engineering could never fix the damage done by the dams. "As the climate changes, whatever God makes is going to be more resilient than what we make," he says, as we ply the canals around Can Tho. "The natural system is always more resilient."

Nguyen is working on other assessments of the dams, but he doesn't expect them to have any more effect than their predecessors. Sometimes he talks about the dams to his older brothers, all of whom have returned to the family land to farm. They just shrug their shoulders. "Nothing we can do about it," they say.

These days Nguyen feels much the same way. "We just have to wait and see," he says. "We have to wait and see what the future is like."

ON A CHILLY EVENING in late January 2013, a group of several dozen local activists gathered near the edge of the Mekong in Ban Huay Luek, a village in northern Thailand. Many were bundled in blankets near impromptu campfires. They'd just finished a 77-mile walk along the river, a protest aimed at drawing public attention to the proposed dams downstream. Led by a cadre of Buddhist monks and joined by a rotating cast of farmers, local politicians, and foreign backpackers, many of these marchers had spent nearly two weeks on the road, camping in the courtyards of schools and temples. "We've done everything we can imagine," said organizer and high school teacher Somkiat Khuenchangsang. "We've researched these dams, we've sent letters, we've walked, we've protested again and again."

That night as the marchers rested their

blistered feet, they listened to speeches from visiting members of parliament. They quieted as Kraisaak Choonhavan, the progressive activist, took the makeshift stage. Thailand, unlike neighboring countries, has a tradition of grassroots organizing and popular protest. Speaking through a scratchy loudspeaker, Choonhavan reminded the audience that years earlier, when the Chinese government was blowing up river rapids in order to clear a section of the Mekong for boat traffic, protesters in northern Thailand had kept them from finishing the job. Some of the veterans of that fight were in the audience. "Without you, they would have blown up everything," Choonhavan said. "So now you have to stand on your feet and use that power again."

### ***The dams would convert more than half the lower Mekong into reservoirs, completely altering the flow of the river.***

The words weren't hollow: Thailand does indeed have influence over the main-stem dams. Thai utilities are the intended market for much of the electricity the dams would produce, and such deals require the approval of the Thai government. Public opposition could persuade it to call for redesigns or even cancellations of dam projects. After the march, a group of 37 villagers, including some of the marchers, pressed forward with a lawsuit against the government. Last summer a national court agreed to hear the case. It's probably too late, though, to stop the Xayaburi dam. Within the next few months, it is expected to reach from bank to bank, closing off the main stem of the lower Mekong for the first time. □

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#### ***On Assignment: One Second A Day***

See photographer and Instagram star David Guttenfelder's entire Mekong assignment flash before your eyes—from the day his young daughters waved goodbye to the day they welcomed him back home.



# Walking the Way

Story and Photographs by

MICHAEL GEORGE



**D**uring the summers of 2012 and 2013, I walked more than a thousand miles on the Camino de Santiago. Also called the Way of St. James, or simply the Way, by English speakers, it is a centuries-old Christian pilgrimage path through France and Spain. In each of the past few years, between 183,000 and 273,000 people from around the world traveled the route, which runs through cities, across mountains, and along Roman roads. It ends at the cathedral in Santiago de Compostela, where the supposed remains of St. James, one of Jesus Christ's Twelve Apostles, are enshrined.

When I walked the Way, I became part of an ancient tradition thriving in a modern world. Though the pilgrimage is rooted in Christian tradition, it has been reborn as a nondenominational spiritual rite. In 2012 only about 40 percent of pilgrims walked in the name of the Christian faith. Others walk because they're in a time of transition—suddenly jobless, recently retired, newly divorced—or simply need a space apart from

"I walked and hurt," George wrote in his journal. The trip took a toll on his feet, but the scenery offset the pain: "I've been told that the most beautiful ten days of walking in all of Europe" are on a part of the trail called Le Puy Route (right).















Along Le Puy Route, George met two Roman Catholic brothers leading a youth group. "On the Camino everyone has time. Everyone has space," George wrote. "It feels like multicultural kindergarten."



their life's routine to decompress, take stock, shift gears. In conversations along the route, I often heard people say, I came to the Camino to find myself or to solve a certain problem. I also heard many say, with confidence and hope, The Camino will show me the way.

There is a spirit of community on the Camino that connects everyone. Within days you will have walked alongside, talked to, and had dinner with many fellow pilgrims. Even if you begin alone, soon you will be surrounded by new friends from all corners of the globe. A community ebbs and flows around you; you never know when someone might disappear. I quickly learned to appreciate my time with others. When a new friend became a speck on the horizon, I felt a familiar sadness.

My pilgrimage ended on the west coast of Spain overlooking the Atlantic. I walked to the lighthouse at sunset and watched people burn their boots as the sky was set on fire. In New York City, where I live, I often felt that my heart was spread so thin that I wasn't feeling much of anything. But there on the cliffs, I realized I was near the end. My heart swelled and then hurt.

I often tell people that what I found on the Camino was a quiet place, a simple reminder of the way life could be. Some would say that is the same as finding God—something to hold on to when times are hard. □

George walked two branches of the path: the Camino Frances, where he photographed pilgrims leaving a hostel in Roncesvalles, Spain (above), and Le Puy Route, where pilgrims shed their footwear before entering an abbey in Conques, France.



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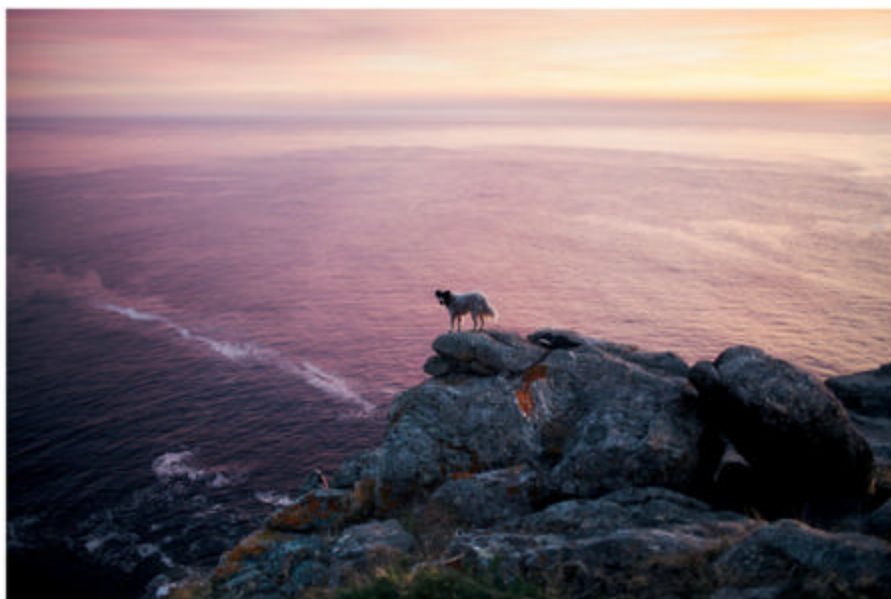




On the route known as the Camino Frances, pilgrims dot a trail across the *meseta*, the plateau of central Spain. "The Camino has no specific stopping point each day," George wrote in his journal. "If you are tired, injured, or fall in love with a town or a person, you can stop." Exploring on foot, he concluded, is "simultaneously the simplest and most intense way to see the world."







During Mass in the cathedral of Santiago de Compostela, smoke billows from the *botafumeiro*, one of the largest incense burners in the world. Many pilgrims celebrate their journey's end at the shrine. George went farther, on what he called a post-pilgrimage, following the Camino de Finisterre route to the westernmost point of Spain. At sunset on the cliffs a dog stood poised "at the end of the Earth."

## In the Loupe

With Bill Bonner, National Geographic Archivist



## Sky Watchers

When a tornado touched down in Vulcan, Alberta, on July 8, 1927, people were taken by surprise. “The crowd gathered in the town streets and eating places and people outdoors suddenly noticed a most peculiar cloud in the southwest,” noted Genevieve L. Sales, a writer for the local *Herald Vulcan*. Occupants of the open auto shown in the loupe—and even the photographer himself—may now seem unwise to have lingered as the twister neared, but Sales explained why they did: “People in the street watched the monster, with keen interest but no fear. Some even went to take pictures... The lack of panic was probably due to the fact that many, never having experienced anything of this nature, simply failed to realize their danger.”

Later, though, they must have realized their luck. The town’s curling rink was razed, and many buildings were damaged, but the storm took no lives that day.

—Margaret G. Zackowitz

PHOTO: MCDERMID PHOTO LABORATORIES/NATIONAL GEOGRAPHIC CREATIVE

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